

## A new species of hemibranchiate sphaeromatid isopod of the genus *Paracilicæa* from Pakistan with the study of developmental stages of the male

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### Abstract

A new species, *Paracilicæa keijii*, of hemibranchiate sphaeromatid isopod is described and illustrated from the rocky intertidal zone of Karachi Coast, Pakistan. Four developmental stages of male are described in detail with the help of illustrations. The relationship of *P. keijii* sp. nov. with two closely allied species and genus *Paracilicæa* Stebbing, 1910 with *Cymodoce* Leach, 1814 are discussed. Attention has also been paid to sexual dimorphism of the species.

### Introduction

Of the thirteen species attributed to the genus *Paracilicæa* (see Harrison & Holdich, 1984) five are described from the east coast of Africa and remaining eight are described from the Australian water. The new species described herein is the fourteenth member of the genus and provides the fourteenth record of the genus from the Arabian sea.

The type material has been deposited at the British Museum (Natural History) Cromwell Road, London. Accession number: Holotype 1989: 106, Paratype 1989: 107.

### *Paracilicæa keijii* sp.nov.

#### Material examined

1 ♂ (10 mm), Manora, Karachi, 27 October, 1981. 1 ♀ (7 mm) mutilated, Manora, Karachi,

26 January, 1983. 1 ♂ (10 mm), 1 ♀ (7 mm), Bulleji, Karachi, 27 August, 1984. 2 subadult ♂♂ (7.1–8.2 mm), 10 ♀♀ (5–6.8 mm), Bulleji, Karachi, 14 October, 1985. 2 ♂♂ (9–10 mm), 7 subadult ♂♂ (5.2–7.1 mm). 4 ♀♀ (4.9–6.2 mm), Manora, Karachi, 7 November, 1987. 6 ♂♂ (8.8–10 mm), 1 subadult ♂ (7.8 mm), 8 ♀♀ (3.5–7.5 mm), 1 ovig. ♀ (8.5 mm), Bulleji, Karachi, 17 January, 1988.

#### Types

Holotype male, 10 mm. (registration No: 1989: 106) This specimen is in much better condition than the male described and has therefore been designated as the holotype. Paratype female, 7 mm. (registration No: 1989: 107).

#### Type locality

Bulleji, Intertidal zone, Karachi, Pakistan 24° 51' N, 66° 48' E.

*Description of adult male (10 mm)*

Body (Fig. 1A) ovate, and punctate dorsally, cephalon with rostral process and supra-antennal margin carinated, eyes wide apart post-laterally situated. Pereonite 1 a little longer than the rest subequal pereonites, 3-6 each with a transverse granulated line and pubescence on dorsal surface, pereonite 7 with almost two granulated lines and a tubercle on each lateral side. Pleon (Fig. 1A) with two long transverse sutures at each side and

two pairs of tubercles on posterior margin. Pleotelson (Fig. 1A) with a proximo-lateral pair of tubercles and large pair of triangular bosses, each extending anteriorly in the form of a ridge to meet with the submedian pair of tubercles on the posterior margin of pleonite 4, thus forming a square-shaped cavity in the middle of dorsal surface, each boss with a lateral setose tubercle at the base, proximal part of pleotelson including bosses highly raised in comparison to strongly depressed and setose distal trilobed portion, disto-median

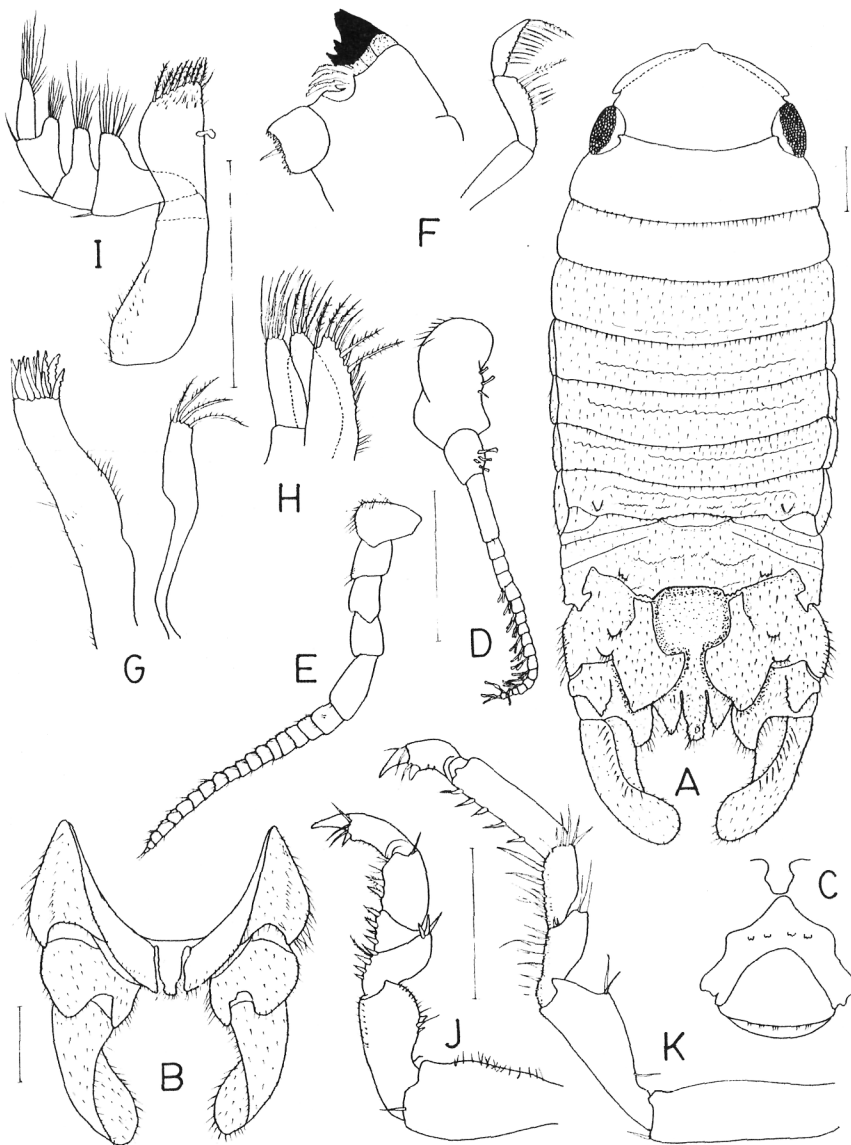


Fig. 1. *Paracilicæa keijii* sp. nov.  
Adult male, 10 mm.  
A, Dorsal view;  
B, Ventral view of pleotelson;  
C, Epistome;  
D, Antenna 1;  
E, Antenna 2;  
F, Mandible;  
G, Maxilla 1;  
H, Maxilla 2;  
I, Maxilliped;  
J, Pereopod 1;  
K, Pereopod 7;  
Scale lines = 1 mm.

lobe bearing a subterminal setose tubercle dorsally. Ventral margin of pleotelson as illustrated in Fig. 1B.

Epistome (Fig. 1C) with antero-lateral margin emarginated, postero-lateral margins elongated with notched lateral sides, posterior surface of labrum with few setae.

Antenna 1 (Fig. 1D) with flagellum composed of sixteen articles, flagellum of antenna 2 (Fig. 1E) eighteen articulated extending to posterior of pereonite 3. Mouthparts and maxilliped as illustrated in Fig. 1F–I.

All pereopods with simple, well developed accessory unguis. Pereopod 1 (Fig. 1J) stout, posterior margins of propodus, carpus and merus with a row of setose spines, antero-distal angle of merus lobed and armed with three spines, antero-median margin of ischium with a group of spines. Posterior margin of propodus of pereopods 2–5 with three and those of 6–7 with five long spines. Posterior margins of carpus and merus of pereopods 2–7 (Fig. 1K) each bearing pads of short and long setae. Antero-median margin of ischium of pereopods 5–7 each produced into a lobe, bearing two to three long setae. Pereopod 7 (Fig. 1K) slender, basis with a seta on postero-distal angle, distal margin of carpus fringed with long setae.

Penes (Fig. 2A) separate to base, elongated, extending to about three fourth length of endopod of pleopod 1, tapering gradually to a narrowly rounded tip.

Pleopod 1 (Fig. 2B) endopod subtriangular bearing short setae medially, peduncle with four coupling spines. Peduncles of pleopods 2–3 (Figs. 2C, D) each with three coupling spines. Pleopod 2 (Fig. 2C) with appendix masculina tapering to a rounded apex, proximally more than half portion densely setulose, distal part slightly curved, extending much beyond the distal margin of endopod. Pleopod 3 (Fig. 2D) exopod with complete subterminal articulation. Pleopods 4–5 as shown in Figs. 2E, F. Uropod rami (Figs. 1A, 3A) densely setose and pubescent. Almost uniramous, endopod highly reduced, exopod well developed, long and thick, apex entire and round, lateral margin and apex curved medially. Sexual dimorphism obvious.

#### *Ovigerous female (8.7 mm)*

Body ovate, surface smooth with weak setation. Mouthparts not completely metamorphosed, mandible partially fused with cephalosome but incisor and molar processes present, maxilla 1 and 2 as those illustrated for the adult male, maxilliped endite (Fig. 3B) with 1 coupling hook, proximal lobes setose and expanded but palp with well developed and setose lobes as found in case of male (Fig. 1I). Pleon and pleotelson pubescent. Pleonite 4 without granulated line with two pairs of tubercles, large triangular bosses smaller than adult male, lacking anteriorly directed ridge, thus not forming square-shaped cavity in the middle of dorsal surface, distal trilobed portion convex, not as flat and setose as that of adult male, distomedial lobe without subterminal tubercle. Uropod with rami subequal not extending as far as pleotelson tip, apex of each ramus distinctly indented but that of exopod always with lateral indentation. Ventral side of pleotelson as in the adult male.

Pereonites 1–4 bearing ostegites at base of each pereopod, hanging freely between pereopods, brood in internal pouches not visible due to opaque ventrum. Harrison (1982) has commented on the structure of the brood pouch in *Paracili-caea*.

#### *Non ovigerous female paratype (7 mm)*

As illustrated in Fig. 2G and described above, but lacking brood pouch.

#### *Colour of specimens in alcohol*

Variable, body pale cream with reddish orange patches all over the dorsal surface. Appendages lacking chromatophores. Eyes almost black.

#### *Ecological note*

This species is one of the common sphaeromatid isopods inhabiting the rocky intertidal coast of

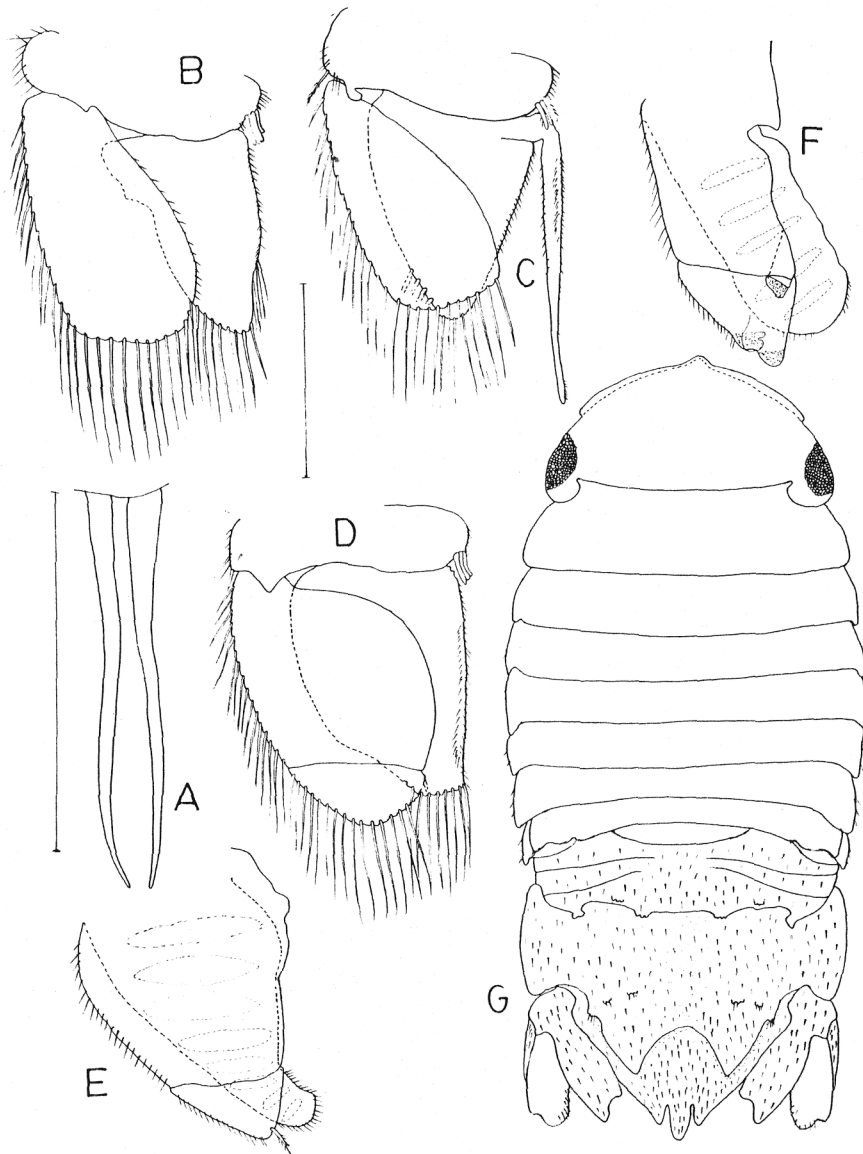


Fig. 2. *Paracilicæa keijii* sp. nov.

Adult male, 10 mm.

A, Penes;

B-F, Pleopods 1-5;

Non ovigerous female paratype, 7 mm.

G, Dorsal view.

Scale lines = 1 mm.

### Etymology

The species is named for Dr. Keijii Baba of Kumamoto University, Faculty of Education, Japan who has been a source of inspiration and encouragement from the beginning of my research career.

### Developmental stages of male

Stage 1 (Figs. 3C, D):

♂ (4.2 mm), Manora, Karachi, 26 October, 1985.

Karachi. It was always found at low tide level under small stones living in groups. The group includes adult males and females as well as developmental stages of the species.

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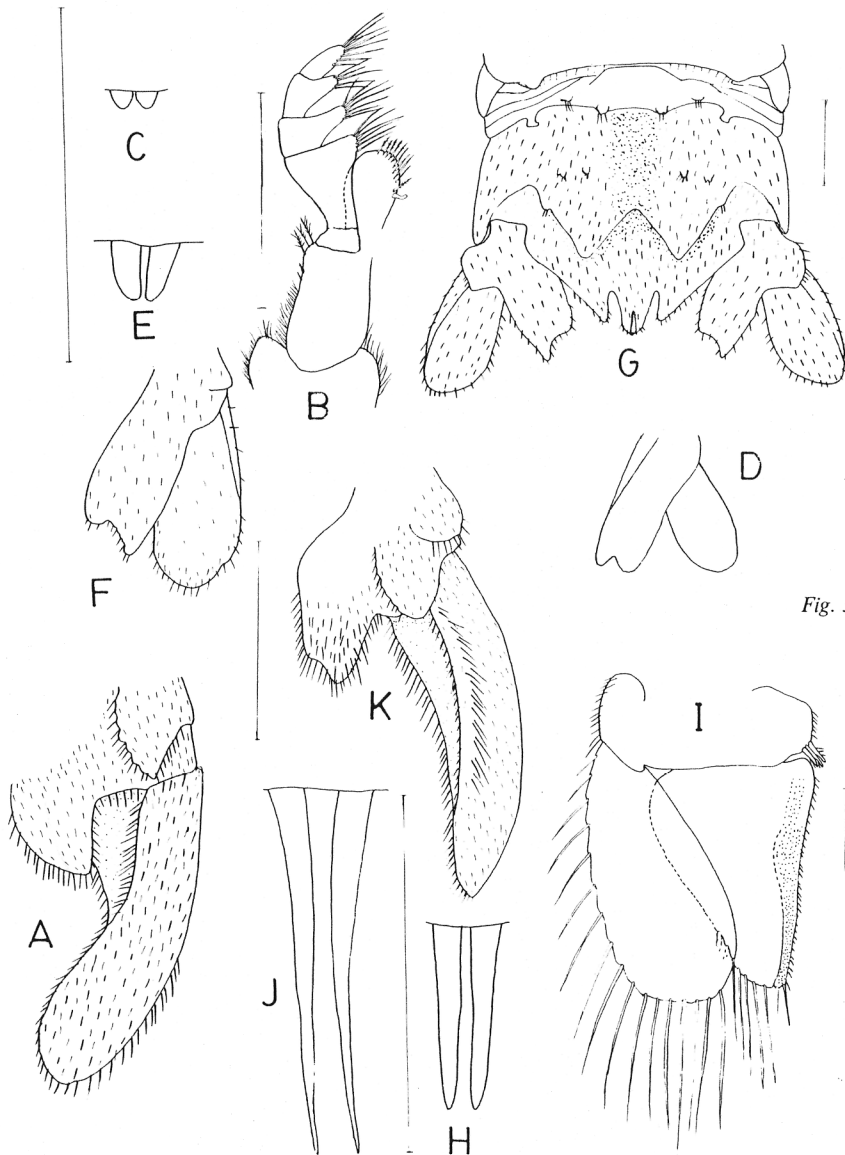


Fig. 3. *Paracilicæa kejii* sp. nov.

Adult male, 10 mm.

A, Uropod.

Ovigerous female, 8.5 mm.

B, Maxilliped.

Developmental stages of male

Stage I, Male, 4.2 mm.

C, Penes;

D, Uropod.

Stage II. Male, 6 mm.

E, Penes;

F, Uropod.

Stage III. Male, 7.7 mm.

G, Pleon and pleotelson, dorsal view;

H, Penes;

I, Pleopod 2.

Stage IV. Male, 7.9 mm.

J, Penes;

K, Uropod.

Scale lines = 1 mm.

Body ovate, noncalcified, glabrous, lacking granulation. Pleonite 4 bearing two minute pairs of tubercles, pleotelson smooth with a pair of small bosses, each with a lateral minute tubercle at base, distal portion convex, disto-medial lobe broad and slightly longer than lateral lobes, notches separating the lobes very shallow.

Penes (Fig. 3C) short, represented by two half circles.

Endopod of pleopod 2 without any trace of appendix masculina. Uropod rami (Fig. 3D)

lamellar, endopod slightly longer than exopod, apex deeply notched, exopod thin, smooth with rounded and entire distal margin.

#### *Stage II (Figs. 3E, F):*

♂ (6 mm), Bulleji, Karachi, 14 October, 1985.

Body surface punctate and pubescent, slightly calcified, pairs of tubercles on pleonite 4 slightly larger. Pleotelson differs from that of the previous specimen in having two proximal pairs of minute tubercles in addition to the lateral tubercles at the

base of each boss. Disto-medial lobe distinctly longer than lateral lobes.

Penes (Fig. 3E) developed into two tube like projections.

Endopod of pleopod 2 without any indication of appendix masculina. Uropod rami (Fig. 3F) subequal, exopod longer than endopod, thickened with marginal setae, endopod lamellar, surface pubescent, apex distinctly notched.

*Stage III (Figs. 3G-I):*

♂ (7.7 mm) Bulleji, Karachi, 14 October, 1988.

Body stiff, fairly calcified, cephalon with weak supra-antennal carina, pereonite 1-7 with marginal setae posteriorly. Pleotelson (Fig. 3G) same as described for the previous stage except that proximal portion is comparatively raised, surface densely pubescent having a depression in the middle, disto-medial lobe (Fig. 3G) convex, bear-

Table 1. Comparison of *P. keijii*, *P. mossambica* and *P. stebbingi* (Characters of adult males are considered).

Features	<i>Paracilicaea keijii</i> sp. nov.	<i>Paracilicaea mossambica</i> Barnard, 1914	<i>Paracilicaea stebbingi</i> Baker, 1926
Pleon	With two pairs of tubercles.	With one pair of minute submedian tubercles on posterior margin (not visible in Barnard's fig. D, pl. 34).	With four longitudinal ridges.
Anterior half of pleotelson	With a tubercle at either side, a square-shaped cavity in the middle formed by anterior extensions of bosses in the form of ridge.	Without tubercle at either side, a square-shaped cavity in the middle formed by anterior extension of bosses in the form of ridge.	Six longitudinal ridges.
Posterior half of pleotelson	A pair of large, highly raised bosses, each with a lateral setose tubercle at base.	A pair of large, densely setose bosses, without lateral tubercle at base.	A pair of large, highly raised bosses without lateral tubercle at base.
Apex of pleotelson	Trilobed, deeply notched, densely setose, median lobe with subterminal knob, longer than lateral lobes.	Trilobed, fairly notched, densely setose, median lobe without subterminal knob, slightly longer than lateral ones, all three lobes with notched apices.	With a broad deep notch, median lobe broad extending half way to lateral lobes.
Penes	Separate to base, very long, with rounded apices.	Long, narrow (not figured by Barnard, 1914).	Separate to base long, with rounded apices.
Appendix masculina	Setulose, much longer than endopod, curved medially.	Spinulose from base to apex much longer than endopod, straight.	Slender, much longer than endopod, curved medially.
Exopod of uropod	Densely setose, elongated, thick, apex round and entire lateral margin and apex curved medially.	Setose, elongated stout, straight, apex narrow and notched.	Inner margin setose, elongated, stout, curving medially with round apex.
Endopod of uropod	Highly reduced, pubescent with marginal setae.	Reduced, narrow, with marginal setae, apex with shallow notch.	Highly reduced, narrow with an unevenly rounded apex.

ing a longitudinal ridge dorsally, separated from lateral lobes by distinct and relatively deep notches.

Penes (Fig. 3H) long, slender, extending to the level of posterior margin of peduncle of pleopod 1.

The peduncle of pleopod 2 (Fig. 3I) armed with three setose coupling spines, outline of future appendix masculina visible through cuticle of endopod, median margin bearing setules and apex two long setae. Uropod rami (Fig. 3G) differ from those of previous stage in their relative length and pubescence, exopod being fairly longer and thicker than reduced endopod, margins entire and fringed with short setae.

#### Stage IV (Figs. 3J, K)

♂ (7.9 mm), Manora, Karachi, 26 February, 1984.

Resembling adult male but body with weak granulated lines. Dorsal depression of pleotelson almost taking the form of square-shaped cavity due to the formation of ridges, distal trilobed portion flat, disto-medial lobe with subterminal tubercle, highly setose, deeply notched laterally.

Penes (Fig. 3J) same as that of adult male but slightly shorter, extending to about half the length of endopod of pleopod 1.

Pleopod 2 with appendix masculina similar to that of adult male. Uropod rami (Fig. 3K) not as fully developed as in the adult male, endopod almost fully reduced but apex slightly notched.

## Discussion

*Paracilicæa keijii* sp. nov. closely resembles *P. mossambicca* Barnard, 1914 from East Africa, in having the square-shaped cavity and a pair of large bosses on the pleotelson (Barnard, 1914, Fig. D, pl. 34). The present species and the closely allied *P. stebbingi* Baker also share a number of characters, including a pair of large conical bosses on pleotelson, uropod with reduced endopod, elongated and curved exopod; long and slender penes and elongated medially curved appendix masculina (Harrison & Holdich, 1984; Figs. 21A, I, D). *P. keijii* is readily diagnosed

from the former by the form and shape of uropodal rami; the shape and length of distal pleotelsonic lobes and setation of dorsal pleotelson and from the latter in having no longitudinal ridges on pleon and pleotelson without a broad deep notch at the apex. The most obvious differences among these three species are summarised in Table 1.

As already stated by Harrison & Holdich (1984: 324) in *Paracilicæa* species sexual dimorphism is obvious. *P. keijii* is also a sexually dimorphic species. It is impossible to identify the females immediately because they are so different from adult males in having subequal and notched rami of uropod (Fig. 2G), pleotelson without square-shaped cavity, distal trilobed portion convex and without thick fringe of setae.

After a long study of collection samples which include adult males and females as well as subadult members of the species together, I was able to realise their identity. In fact, the study of the development of male proved very helpful. It is noteworthy that subadult males are almost similar to females in appearance. In having biramous uropods they appear similar to members of the genus *Cymodoce* Leach, but as the young males grow, they gradually lose the endopod of uropod. So, the uniramous uropod of male is apomorphic (derived) whereas the biramous condition of uropod in females is plesiomorphic (primitive) suggesting the close phyletic relationship of *Paracilicæa* Stebbing, 1910 to the genus *Cymodoce* Leach, 1914.

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