

Taxonomy and Distribution of Corycaeidae (Copepoda: Cyclopoida) in the Korean Waters in Summer

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한국 연근해에서 하계에 출현하는 Corycaeidae (Copepoda : Cyclopoida)의 분류 및 분포

강영실 · 허성희 · 이삼석

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The family Corycaeidae in the neighbouring seas of Korea was taxonomically studied based on the zooplankton samples collected in August, 1986. In this study, nine species belonging to two genera and three subgenera of the Corycaeidae were identified and described with illustrations; *Corycaeus (Corycaeus) speciosus*, *C.(C.) crassiusculus*, *C.(Ditrichocorycaeus) affinis*, *C.(D.) andrewsi*, *C.(D.) erythraeus*, *C.(Onychocorycaeus) pacificus*, *C.(O.) catus*, *C.(O.) agilis*, and *Farranula gibbula*. The distribution patterns of these species showed that *C.(D.) affinis* appeared to be an indicator species of the coastal waters, and *C.(C.) speciosus*, *C.(C.) crassiusculus*, *C.(O.) catus*, *C.(D.) andrewsi*, and *Farranula gibbula* appeared to be indicator species of the warm-oceanic waters.

1986년 8월 한국 연근해에서 출현하는 Corycaeidae를 분류학적으로 연구하였다. 본 연구에서 기재된 종은 2속 3아속 9종으로 *Corycaeus (Corycaeus) speciosus*, *C.(C.) crassiusculus*, *C. (Ditrichocorycaeus) andrewsi*, *C. (D.) erythraeus*, *C. (D.) affinis*, *C. (Onychocorycaeus) agilis*, *C. (O.) pacificus*, *C. (O.) catus*, *Farranula gibbula*였다. 각 출현종의 분포를 보면 *C. (O.) affinis*는 연안, 내만성종의 특성을 나타내었으며, *C. (C.) speciosus*, *C. (C.) crassiusculus*, *C. (D.) andrewsi*, *C. (D.) catus* 및 *Farranula gibbula*는 난류, 외양성종의 특성을 나타내었다.

INTRODUCTION

The family Corycaeidae was established by Dana in 1845, and 57 species of corycaeids have been reported so far (Lakkis et Zeidane, 1987). Many species of this family are widely distributed in the warm waters of the ocean and known to be important as indicator species (Tanaka, 1957; Motoda, 1963).

Extensive studies on the taxonomy and geographical distribution of corycaeids have been

made in various regions of the world (Mori, 1937; Wilson, 1942; Sewell, 1947; Farran, 1949; Tanaka, 1957; Motoda, 1963; Owre and Foyo, 1967; Chen *et al.*, 1974).

In Korean waters, the distribution of corycaeids have been reported by several investigators (Hue, 1967; Lee, 1972; Park *et al.*, 1973; Shim and Ro, 1982; Kim and Huh, 1983; Shim and Lee, 1983, 1986), but the taxonomical study of this family has not been made yet.

The present study aims to provide taxonomi-

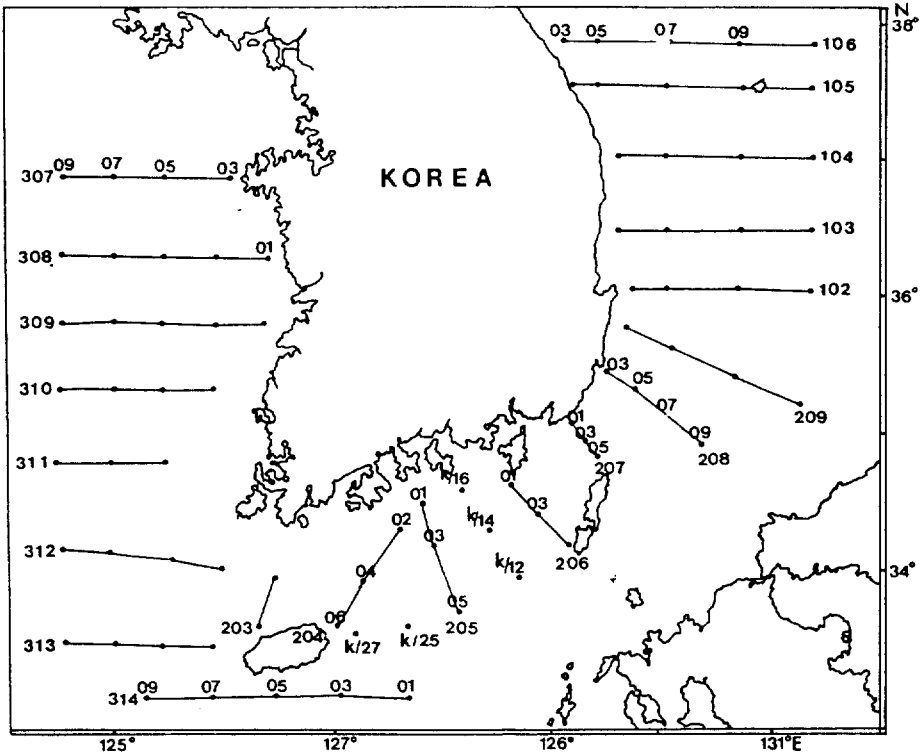


Fig. 1. Map of sampling stations.

cal and distributional informations on the family Corycaeidae in Korean waters, and to elucidate the geographical distribution of corycaeids in relation to oceanographical features.

MATERIALS AND METHODS

The zooplankton samples used in this study were collected from 83 stations in neighbouring seas of Korea in August, 1986 (Fig. 1).

The samples were collected by a NORPAC net with 0.45m mouth diameter. The mesh aperture of the net used was 330 μ m. The net was towed vertically from the bottom to the surface in the Southern Sea and Yellow Sea, and from 100m depth to the surface in the Eastern Sea of Korea with a hauling speed of 0.5-1.0 m/sec. Immediately after haul, zooplankton samples were preserved in a 5% neutral formalin seawater solution.

Corycaeids in the samples were identified and

counted under a compound microscope. Specimens requiring detailed observations were sorted out, stained with methyl blue, dissected on a slide glass, and examined under a compound microscope.

All illustrations were made with the aid of drawing tube, and the body length was measured from the tip of the forehead to the distal end of the caudal ramus.

Each scale bar represents 0.05mm. Body structures were described according to the criteria defined by Owre and Foyo (1967).

Abbreviations used in the description are listed as following:

Th1-Th5	Thorax segments 1-5
A1-A2	Antennae 1-2
P1-P4	Swimming legs 1-4
B1-B2	Basal segments 1-2
Ri	Endopod
Re	Exopod
Ril-Ri3	Endopod segments 1-3
Rel-Re3	Exopod segments 1-3

RESULTS AND DISCUSSION

Systematics

The systematics adopted in the present study is according to M. Dahl's work (1912).

Nine species, representing 2 genera of Corycaeidae were identified. The species of Corycaeidae found in this study are listed as follows:

- Phylum Arthropoda
 Class Crustacea
 Subclass Copepoda
 Order Cyclopoida
 Family Corycaeidae Dana, 1852
 Genus *Corycaeus* Dana, 1945
 Subgenus *Corycaeus* M. Dahl, 1912
 1. *C. (Corycaeus) speciosus* Dana, 1845
 2. *C. (Corycaeus) crassiusculus* Dana, 1849
 Subgenus *Ditrichocorycaeus* M. Dahl, 1912
 3. *C. (Ditrichocorycaeus) andrewsi* Farran, 1911
 4. *C. (Ditrichocorycaeus) erythraeus* Cleve, 1904
 5. *C. (Ditrichocorycaeus) affinis* McMurrich, 1916
 Subgenus *Onychocorycaeus* M. Dahl, 1912
 6. *C. (Onychocorycaeus) agilis* Dana, 1849
 7. *C. (Onychocorycaeus) pacificus* F. Dahl, 1912
 8. *C. (Onychocorycaeus) catus* F. Dahl, 1894
 Genus *Farranula* Wilson, 1932
 9. *Farranula gibbula* (Giesbrecht), 1891

Descriptions of species

Family Corycaeidae

Generally the head with a pair of lenses; A1 with 3-6 segments, and A2 with uniramous, and terminate into the hooks. P4 with Ri sometimes degenerating to the knobs or setae.

Key to the genera of Corycaeidae

1. Urosome 1-segmented *Farranula*
2. Urosome 2-segmented *Corycaeus*

Genus *Corycaeus* Dana, 1945

Abdomens of male and female usually 2-segmented; Th3 and Th4 distinctly separated, the latter with lateral points. A2 with the setae on B1, and B2 not feathered. P4 with Ri bearing one or two setae.

Key to the subgenera of *Corycaeus*

1. P4-Ri with 2 setae *Ditrichocorycaeus*

- P4-Ri with 1 seta 2
2. Caudal rami half the length of genital segment (female); Terminal spine on A2 longer than B1 + B2 (male) *Onychocorycaeus*
 Caudal rami over half the length of genital segment (female); Terminal spine on A2 shorter than B1 + B2 (male) *Corycaeus*

Subgenus *Corycaeus* M. Dahl, 1912

Urosome 2-segmented, and Re of P1 to P3 with 1,1,3 spines on the outer edge. P4-Ri a prominence with one long seta. Genital segment without a ventral process. Gaudal rami of female divergent.

Key to the species of *Corycaeus*

1. Caudal rami as long as the urosome; The lateral points of Th3 approximately 2/3 the length of the genital segment (female); A2 with one long sharp tooth at the inner distal edge of B2 (male) *Corycaeus speciosus*
2. Caudal rami approximately 2/3 the length of urosome; the lateral points of Th3 approximately as long as genital segment (female); A2 with one short, sharp tooth at the inner distal edge of B2 (male) *Corycaeus crassiusculus*

1. *Corycaeus (Corycaeus) speciosus* Dana, 1849
(Plate 1 Figs. A-G)

C. speciosus Dana, 1849, pl. 14, figs. 9-14; Brady, 1883, p. 115, pl. 46, figs. 5,6; Giesbrecht, 1892; p. 673, pl.5, figs. 39,40; F. Dahl, 1894, p. 73; Thompson and Scott, 1903, p. 285; Breemen, 1908, p. 199, fig. 212, a,b; A. Scott, 1909, p. 251; Wilson, 1932, p. 358, fig. 216, a,b; 1942, p. 182; 1950, p. 196; Mori, 1937, p. 133, pl. 72, figs. 9-15; Farran, 1936, p. 134, figs. 12, 13.

C. (Corycaeus) speciosus M. Dahl, 1912, p. 13, pl.1, figs. 1-13, pl. 2, figs. 1-4; Rose, 1933, p. 323, fig. 422; Sewell, 1947, p. 276; Krishnaswamy, 1953, p. 70, figs. 12, 13; Tanaka, 1957, p. 79, pl. 3, figs. 1-6; Motoda, 1963, p. 213, fig. 3; Chen *et al.*, 1974, p. 90, pl. 14, figs. 9-13.

Material examined: 1 female (St. 314/01), 2 males (St. 314/03)

Description:

Female: Cephalothorax 4-segmented, and the lateral points of Th3 over half the length of the genital segment; Caudal rami as long as the urosome and divergent.

Male: The lateral points of Th3 over half the length of the genital segment. A2 with one long, sharp tooth at the inner distal edge of B2.

Caudal rami 12 times longer than wide and 4/5 the length of the urosome.

Length: Female-1.85mm, Male-1.58mm

Remarks: Motoda (1963) noted that the length of seta on A2-B1 was 2.8 times that of A2-B2. The seta on A2-B1 of the present specimen was 3 times as long as that of A2-B2.

Distributions: St. 208/03, 05; 207/05; 206/01, 05; 205/05; K/12; 314/01, 03, 05

2. *Corycaeus*(*Corycaeus*) *crassiusculus* Dana, 1949
(Plate 1, Figs. H-O)

C. crassiusculus Dana, 1849, pl. 15, 1-5; F. Dahl, 1894, p. 73; Farran, 1929, p. 291, fig. 36, a,b; 1936, p. 134, fig. 8, c,d; Mori, 1937, p. 133, pl. 75, figs. 1-5; Wilson, 1950, p. 193.

C. danae Giesbrecht, 1892, p. 673, pl. 51, figs. 59, 60; 1895, p. 261.

C. (Corycaeus) crassiusculus M. Dahl, 1912, p. 21, taf. 3, figs. 1-7; Sewell, 1947, p. 272, fig. 69, a-h; Tanaka, 1957, p. 80, pl. 3, figs. 12-15; Motoda, 1963, p. 218, fig. 5; Chen *et al.*, 1974, p. 91, pl. 15, figs. 1-5.

Material examined: 2 females (St. 205/01,05), 1 male (St. 207/05)

Description:

Female: Cephalothorax 5-segmented. The lateral points of Th3 extended to the end of the genital segment; Caudal rami less divergent than those of *C. speciosus*; Genital segment overlapped the anal segment at the dorsal margin. Caudal rami 6 times longer than wide and 2/3 the length of the urosome.

Male: Cephalothorax 3-segmented, The lateral points of Th3 less slender than that of *C. speciosus*, and extended to 1/2 the genital segment. The distal corner of inner edge of A2-B2 less pointed out than that of *C. speciosus*.

Length: Female-1.59mm, 1.66mm, Male-1.45mm

Remarks: The present specimens were longer than Tanakas (1957)'s specimens (female, 1.44-1.50mm; male, 1.27-1.36mm) and similar to Chen *et al.* (1974)'s specimens (female, 1.72-1.85mm; male, 1.35-1.65mm).

Tanaka(1957) and Motoda(1963) also pointed out that the genital segment was overlapped the anal segment at the dorsal margin.

Distributions: St.208/03,05,07,09; 207/05; 205/01,05; k/12

Subgenus *Ditrichocorycaeus* M. Dahl, 1912

Urosome 2-segmented, and P4-Ri a prominence with two long setae. Caudal rami of female divergent.

Key to the species of *Ditrichocorycaeus*

1. With one ventral process on the genital segment (male, female)2
 - Without one ventral process on the genital segment (male, female); The lateral genital segment swollen (male) *C. (Ditrichocorycaeus) andrewsi*
2. Anal segment approximately as long as the genital segment; With a small divergent caudal rami (female)
 - Anal segment shorter than the genital segment; With a large divergent caudal rami (female); The

lateral points of Th3 approximately 1/3 the length of the genital segment; with one ventral process on the genital segment (male)
..... *C. (Ditrichocorycaeus) affinis*

3. *Corycaeus*(*Ditrichocorycaeus*) *andrewsi* Farran, 1911
(Plate 2, Figs. A-H)

C. andrewsi Farran, 1911, p. 294, pl. 13, 14; 1936, p. 138
C. (Ditrichocorycaeus) andrewsi M. Dahl, 1912, p. 78, taf. 9, figs. 10-18; Tanaka, 1957, p. 86, pl. 6, figs. 7-12; Chen *et al.*, 1974, p. 95, pl. 19, figs. 1-7.

C. trukicus Mori, 1937, p. 137, pl. 75, figs. 9-16.

Materials examined: 1 female (St. 314/03), 1 male (St. K/12)

Description:

Female: Genital segment with cilia on the proximal portion of the ventral side. The proximal inner edge of the genital segment rectangular in the lateral view. The seta on A2-B2, 2/3 the length of the seta on A2-B1.

The distal inner edge of A2-B2 furrowed. Anal segment shorter than the genital segment, and as long as the caudal rami.

The proportional length of the genital segment, anal segment, and caudal rami were 24:15:14.

Male: Head separated from Th1, the lateral points of Th3 extended to approximately 1/3 the length of the genital segment. A2 with a teeth row on the central part of B2. The lateral genital segment swollen like an ovary.

Length: Female-0.93mm, Male-1.04mm

Remarks: Tanaka(1957) reported that there were many cilia on the anterior and posterior part of the ventral side of the genital segment in female. The present specimen had cilia only on the anterior ventral side.

Distributions: St. k/12; 314/01, 03

4. *Corycaeus*(*Ditrichocorycaeus*) *erythraeus* Cleve, 1901
(Plate 2, Figs. I-L)

C. erythraeus Cleve, 1901, pl. 20, figs. 1-9; Gurney, 1927, p. 161, fig. 23, a-d; Farran, 1936, p. 137.

C. dubius Farran, 1911, p. 292, pl. 12, 14; Wilson, 1942, p. 180, fig. 40; 1950, p. 193.

C. (Ditrichocorycaeus) dubius M. Dahl, 1912, p. 71, taf. 10, figs. 11-19; Tanaka, 1957, p. 88, pl. 7, figs. 5-13.

C. (Ditrichocorycaeus) erythraeus Tanaka, 1960, p. 81, pl. 36, figs. 1-8; Chen *et al.*, 1974, p. 96, pl. 20, figs. 1-9.

Materials examined: 4 females (St. 307/10, 309/01,10)

Description:

Female: Head separated from Th1; The lateral points of Th3 extended to 1/2 the genital segment. Genital segment as long as the anal segment, and with one ventral process. Caudal rami small divergent, and 10 times as long as width. Apical spine of

P2-Re with 2-3 teeth on the inner anterior side. The seta on A2-B1 approximately 3 times as long as seta on A2-B2.

Length: Female: 0.85-0.93mm

Remarks: It was reported that apical spine of P2-Re had about 5 teeth on the inner anterior side (Tanaka, 1960) and 1-2 teeth on the same part (Chen *et al.*, 1974), but the specimen in this study had 2-3 teeth. Tanaka (1960) pointed out that head was separated from Th1: caudal rami was a little divergent, and its length as 10 time as long as width. In the present study no male was found.

Distributions: St. 103/11; 207/01; 209/05; 313/07; 307/05, 07, 09, 10; 309/01, 03, 10

5. *Corycaeus*(*Ditrichocorycaeus*) *affinis*

McMurrich, 1916

(Plate 3, Figs. A-G)

C. affinis McMurrich, 1916, p. 17, figs. 8-16; Davis, 1949, p. 75, figs. 179-183.

C. japonicus Mori, 1937, p. 138, pl. 76, figs. 1-11.

C. (Ditrichocorycaeus) affinis Tanaka, 1957, p. 92, pl. 3, figs. 6-15; Chen *et al.*, 1974, p. 93, pl. 17, figs. 8-16.

Materials examined: 27 females, 50 males (all the study areas except st. 309/09, 103/05, 106/07)

Description:

Female: Caudal rami divergent and approximately 7-8 times longer than width. The dorsal surface of the genital segment vaulted. The seta on A2-B1 3 times as long as the seta on A2-B2. Apical spine of P2-Re with 2-3 teeth on the inner anterior side. Genital segment as long as the caudal rami, and the genital segment with one ventral process.

Male: The lateral points of Th3 extended to 1/3 the genital segment. Genital segment with one ventral process like a hook.

Caudal rami about 7 times longer than width. A2-B2 with one row of strong teeth on the outer distal and one row of fine teeth on the central part.

Length: Female: 0.87-1.25mm, Male: 0.80-1.12mm

Remarks: Tanaka (1957) reported that the length of the caudal rami of female was 9 times its width and 1.7 times the anal segment. Chen *et al.* (1974) reported that the length of the caudal rami of female was 7 times its width and 1.6 times the anal segment. The specimen in the present study, the length of the caudal rami of female was 7-8 times its width.

Distributions: All survey stations except St. 309/09, 103/05, 106/07

Subgenus *Onychocorycaeus* M. Dahl, 1912

Re of P1 to P3 with 1, 1, 3 spines on the outer edge; Urosome 2-segmented; P4-B2 without a prominence on the distal inner edge, and P4-Ri, a small prominence with two long setae.

Th3 of female, very wide and strong, and 2/3 the length of the cephalothorax. Male with one process on the

ventral side of the genital segment. The terminal claw of A2 as long as B1 + B2.

Key to the species of *Onychocorycaeus*

1. Genital segment shorter than the caudal rami (female) *C. (Onychocorycaeus) agilis*
2. Lateral points of Th4 dull; Lateral points of Th3 shorter than 1/2 the length of the genital segment (female); Genital segment without a process on the ventral side (male) *C. (Onychocorycaeus) pacificus*
 - Lateral points of Th4 keen; Lateral points of Th3 beyond 1/2 the length of the genital segment (female); Genital segment with one process on the ventral side (male) *C. (Onychocorycaeus) catus*

6. *Corycaeus*(*Onychocorycaeus*) *agilis* Dana, 1849
(Plate 3, Figs. H-K)

C. gracilicaudatus Giesbrecht, 1892, p. 674, taf. 51, figs. 15, 30; A. Scott, 1909, p. 249.

C. (Onychocorycaeus) agilis M. Dahl, 1912, p. 84, taf. 12; Dakin and Colefax, 1940, p. 113, fig. 189 a-b; Sewell, 1947, p. 284; Tanaka, 1957, p. 94, pl. 8, figs. 16-18, pl. 9, figs. 1-5; 1960, p. 83, pl. 36, figs. 4-5; Motoda, 1963, p. 238, fig. 14.

C. agilis Dana, 1849, pl. 20, figs. 10-13; Farran, 1936, p. 138; Mori, 1937, p. 134, pl. 72, figs. 1-2; Wilson, 1942, p. 179; 1950, p. 102.

Materials examined: 2 females (St. 208/07)

Description:

Female: Cephalothorax 5-segmented and shorter than the caudal rami; The lateral points of Th3 extended to 1/4 the genital segment. Urosome 1.4 times as long as the cephalothorax and slender.

Length: Female-0.95 mm

Remarks: Tanaka (1957) pointed out that the length of the cephalothorax was 1.5 times abdomen, and the ratio of the length of the genital segment against the caudal rami was 3.5: 3.6. In the present specimen, the former was 1.4, the latter was 2.0:2.2. In the present study no male was found.

Distributions: St. 208/05, 07; 102/09

7. *Corycaeus*(*Onychocorycaeus*) *pacificus* F. Dahl, 1912
(Plate 4, Figs. A-D)

C. pacificus F. Dahl, 1912, pl. 21, figs. 1-7; Farran, 1936, p. 139; Wilson, 1942, p. 182; 1950, p. 195.

C. (Onychocorycaeus) pacificus M. Dahl, 1912, p. 103, taf. 14; Sewell, 1947, p. 285; Tanaka, 1957, p. 95, pl. 9, figs. 13-20; 1960, p. 85, pl. 37, figs. 1-3; Chen *et al.*, 1974, p. 97, pl. 21, figs. 1-7.

C. catus Mori, 1937, p. 74, figs. 1-7.

Material examined: 3 females, 3 males (St. 208/09)

Description:

Female: Cephalothorax 5-segmented and robust. Th3 swollen large, and the lateral points of Th3 extended to 3/4 the genital segment. The lateral points of

Th4 very short and dull. Genital segment longer than the caudal rami. Caudal rami 4 times longer than width. Apical spine of P2-Re with 2 teeth on the inner anterior side. P4-Ri one small prominence with one long seta.

Male: Th3 fused with Th4, and the lateral points of Th3 shorter than 1/2 the length of the genital segment. Genital segment with an oval form. Caudal rami 7 times longer than width.

Length: Female-1.12mm, Male-1.04mm

Remarks: Tanaka(1957) pointed out that the length of caudal rami was 5 times its width in female and 8 times its width in male. In the present specimen, the former was 4 times and the latter was 7 times. Also, Tanaka(1957) mentioned that female had one tooth on the inner anterior side of apical spine of P2-Re. The present specimen had two teeth.

Distributions: St. 105/07; 103/11; 209/11; 208/01, 03, 05, 07, 09; 207/05; 206/01, 03, 05; 204/02; 205/05; k/12, 25; 314/01, 05, 09

8. *Corycaeus(Onychocorycaeus) catus* F. Dahl, 1894
(Plate 4, Figs. E-I)

C. obtusus Giesbrecht, 1892, p. 673, taf. 51, figs. 12-14.

C. catus F. Dahl, 1894, pl. 21, figs. 8-13; Farran, 1911, p. 290, figs. 1-3; 1936, p. 138; Mori, 1937, p. 136, pl. 74, figs. 8-10; Wilson, 1942, p. 180; 1950, p. 192; Motoda, 1963, p. 242, fig. 16.

C.(Onychocorycaeus) catus M. Dahl, 1912, p. 99, taf. 13, figs. 17-24; Sewell, 1947, p. 284; Tanaka, 1957, p. 94, pl. 9, figs. 6-12; Chen *et al.*, 1974, p. 97, pl. 21, figs. 8-13.

Material examined: 2 females (St. 208/07, 09), 1 male (St. 208/09)

Description:

Female: Cephalothorax 4-segmented; The lateral points of Th4, keen and long; Caudal rami 4 times longer than width and as long as the anal segment. The outer edge spine of the 1st segment of P4-Re, beyond to the 2nd segment; the outer edge spine of the 3rd segment of P4-Re approximately as long as the 3rd segment.

Male: Cephalothorax 5-segmented; The lateral points of Th3 extended to 1/2 the genital segment; Genital segment with one process on the ventral side.

Length: Female: 0.87-0.95mm, Male: 0.85mm

Remarks: Tanaka(1957) and Chen *et al.* (1974) reported that the length of the caudal rami of female was 4 times and 3.5 times its width respectively.

The present specimen agreed with Tanaka's result.

Distributions: St. 209/07, 09; 208/07, 09; 207/05; k/12; 314/01, 03

Genus *Farranula* Wilson, 1932

Urosome(male, female) 1-segmented; Th4 without the lateral points and not separated from Th3. Each seta of

A2-B1, B2 feathered with long bristles. A2 of male with one short terminal claw, and feathered on the inner distal edge of B2. R2 of P1 to P4 with 0, 0, 1 spines on the outer edge, and P4 without Ri.

9. *Farranula gibbula* (Giesbrecht), 1892
(Plate 4, Figs. J-P)

Corycaeus gibbulus Giesbrecht, 1892, p. 675, taf. 51, figs. 22-23; F. Dahl, 1894, p. 69; Thompson and Scott, 1903, p. 286; Mori, 1937, pl. 76, figs. 12-16, pl. 77, figs. 1-4.

Corycella gibbulus Farran, 1911, p. 284; 1936, p. 139.

Corycella brevis Farran, 1911, p. 285, pl. 10, figs. 1-6, pl. 11, fig. 7.

Corycaeus (Corycella) gibbulus M. Dahl, 1912, p. 115, taf. 15; Tanaka, 1957, p. 96, pl. 10, figs. 6-11; Chen *et al.*, 1974, p. 38, pl. 22, figs. 7-12.

Farranula gibbula Wilson, 1950, p. 228; Motoda, 1963, p. 83, fig. 27.

Material examined: 1 female (St. 208/09), 1 male (St. 208/07)

Description:

Female: Urosome 1-segmented; The middle part of the genital segment swollen. Genital segment with a lot of cilia on the proximal ventral part. The distal corner of the inner and outer part of Th4 protruded.

Male: Urosome 1-segmented and with bristles on the distal ventral part.

Length: Female-0.88mm, Male-0.93mm

Remarks: This specimen of female agreed with Motoda's (1963) description as the prominences of the inner and outer margins of Th4. Motoda(1963) pointed out that P4-Re3 had 5 setae, but this specimen had 6 setae. M. Dahl (1912) had reported that males of *C. gibbulus* and *C. concinnus* were similar, and they could be distinguished from the difference of the body length, and the former was 0.80-0.87mm and the latter was 0.73-0.78mm.

The body size of the specimen on this study appeared larger than that of M. Dahl (1912).

Distribution: St. 209/09, 11; 208/05, 07, 09; 314/01; k/12

Geographical distribution

1. The Oceanographical condition

Fig. 2 shows the distributions of temperature and salinity at 30m depth in the neighbouring seas of Korea in August, 1986.

The range of temperature was 6.3-18.7°C in the Yellow Sea, 8.1-23.4°C in the Southern Sea, and 10.4-16.7°C in the Eastern Sea (Sea of Japan). The waters warmer than 20°C were

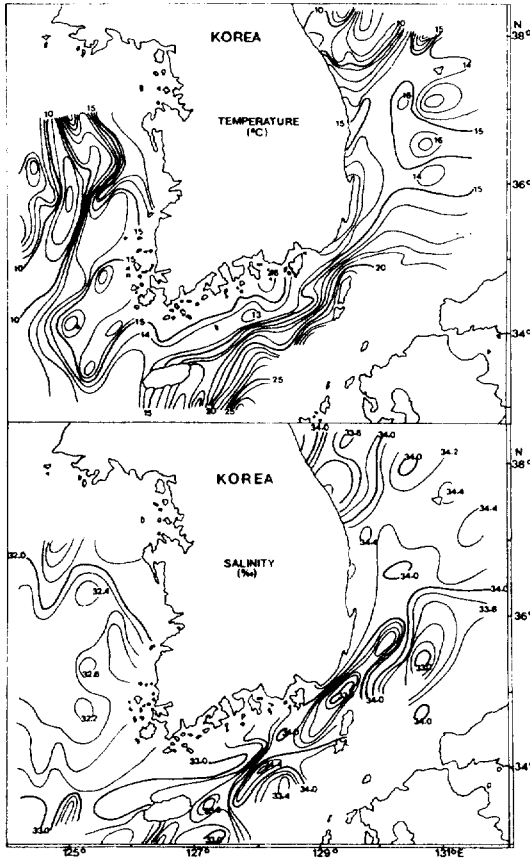


Fig. 2. Distributions of temperature and salinity at 30m depth in August, 1986.

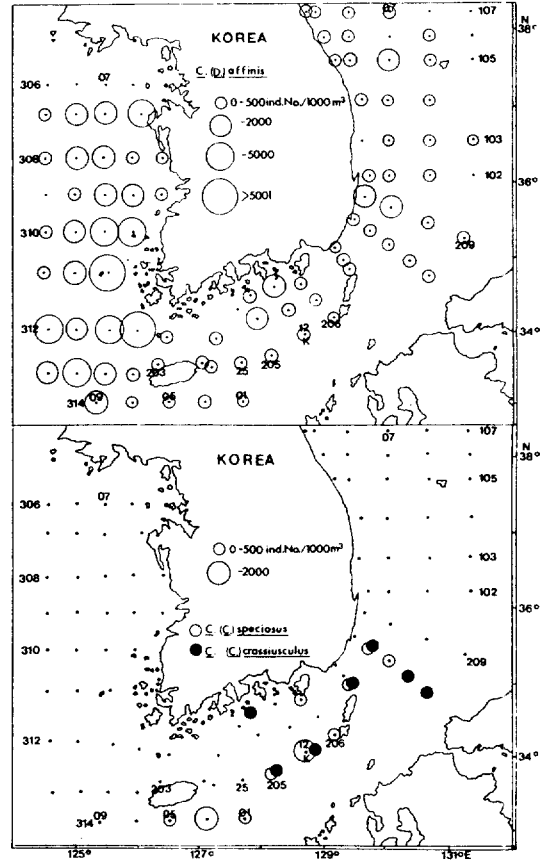


Fig. 3. Distributions of *Corycaeus* (*Ditrichocorycaeus*) *affinis*, *C. (Corycaeus) speciosus* and *C. (C.) crassiusculus*.

found in the Southern Sea between Cheju Island and Tsushima Island. The high temperature in this area is due to the Tsushima Warm Current which is a branch of the Kuroshio Current. In the Southern Sea, the thermal front was formed along the boundary between the two water masses of relatively cold coastal water and of the Tsushima Warm Current Water.

The range of salinity was 32.1-33.0‰ in the Yellow Sea, 33.0-34.4‰ in the Southern Sea, and 33.0-34.4‰ in the Eastern Sea. The salinity in the Yellow Sea was about 1-2‰ lower than that in the Southern Sea or Eastern Sea. This relatively low salinity in the Yellow Sea is mainly due to freshwater discharged from rivers, in particular, the Yangtze River (Kang and Jin, 1984).

2. Distribution of corycaeids

Among nine species identified in this study, *C. (D.) affinis* and *C. (D.) erythraeus* were found in the Yellow Sea, and *C. (C.) speciosus*, *C. (C.) crassiusculus*, *C. (D.) affinis*, *C. (D.) andrewsi*, *C. (O.) pacificus*, *C. (O.) catus*, *C. (O.) agilis* and *Farranula gibbula* in the Southern and Eastern Sea.

In other studies, 10 species of corycaeids (*C. crassiusculus*, *C. speciosus*, *C. longistylis*, *C. affinis*, *C. erythraeus*, *C. pacificus*, *C. catus*, *C. gibbulus*, *C. lautus* and *C. clausi*) have been reported from the Eastern Sea (Hue, 1967; Shim and Lee, 1986), 18 species (*C. affinis*, *C. gibbulus*, *C. andrewsi*, *C. crassiusculus*, *C. catus*, *C. ovalis*, *C. speciosus*, *C. lautus*, *C. agilis*, *C.*

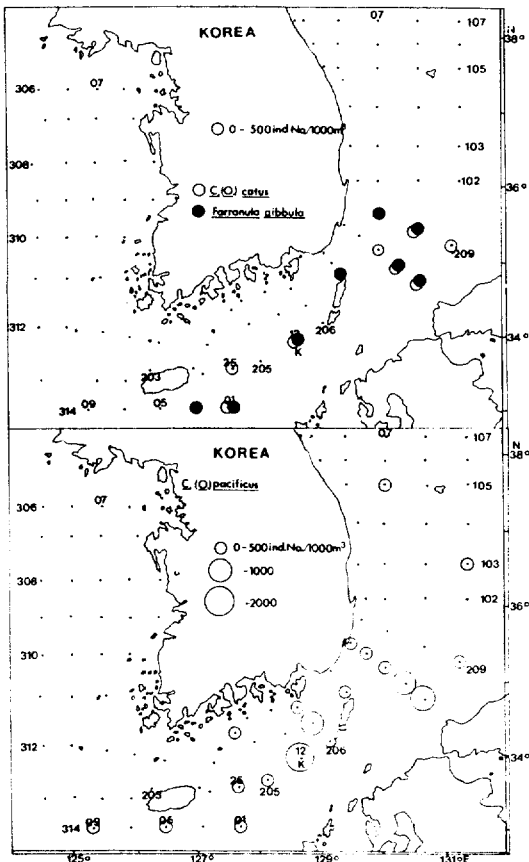


Fig. 4. Distributions of *Corycaeus (Onychocorycaeus) catus*, *Farranula gibbula* and *C.(O.) pacificus*.

rostratus, *C. asiaticus*, *C. limbatus*, *C. clausi*, *C. longistylis*, *C. pacificus*, *C. dahli*, *C. dubius* and *C. trukicus*) from the Southern Sea (Lee, 1972; Park *et al.*, 1973; Shim and Ro, 1982), and 2 species (*C. affinis* and *C. gibbulus*) from the Yellow Sea (Kim and Huh, 1983; Shim and Lee, 1983).

C. affinis was a widespread species and was distributed in the almost all survey areas in this study (Fig. 3). Especially, this species was found abundantly in the Yellow Sea and the coastal areas of the Southern Sea and the Eastern Sea where water temperature was relatively low. However, its abundance decreased in the areas influenced strongly by the Tsushima Warm Current. Hue (1967) reported that this species was distributed more abundantly in the coastal

waters than in the offshore waters in the Eastern Sea, and Lee (1972) reported that *C. affinis* was one of the dominant copepods in the coastal areas of the Southern Sea.

In contrast to *C. affinis*, the distributions of *C. speciosus*, *C. crassiusculus*, *C. catus*, *C. andrewsi* and *F. gibbula* were restricted mainly to the warm oceanic waters influenced by the Tsushima Warm Current with high temperature and high salinity (Figs. 3,4). However, these species were not found in the Yellow Sea. Yamaji (1956) also indicated that *C. andrewsi* was the warm oceanic species and the indicator species of the Kuroshio Current.

Thus, coryceids in Korean waters can be separated into two groups based on the distribution patterns; one group occurring in the coastal waters with relatively low temperature (i.e. neritic species) and the other group occurring in warm oceanic waters influenced by the Tsushima Current (i.e. warm oceanic species). While *C. affinis* belongs to the first group, *C. speciosus*, *C. crassiusculus*, *C. catus*, *C. andrewsi* and *F. gibbula* belong to the second group.

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PLATE 1

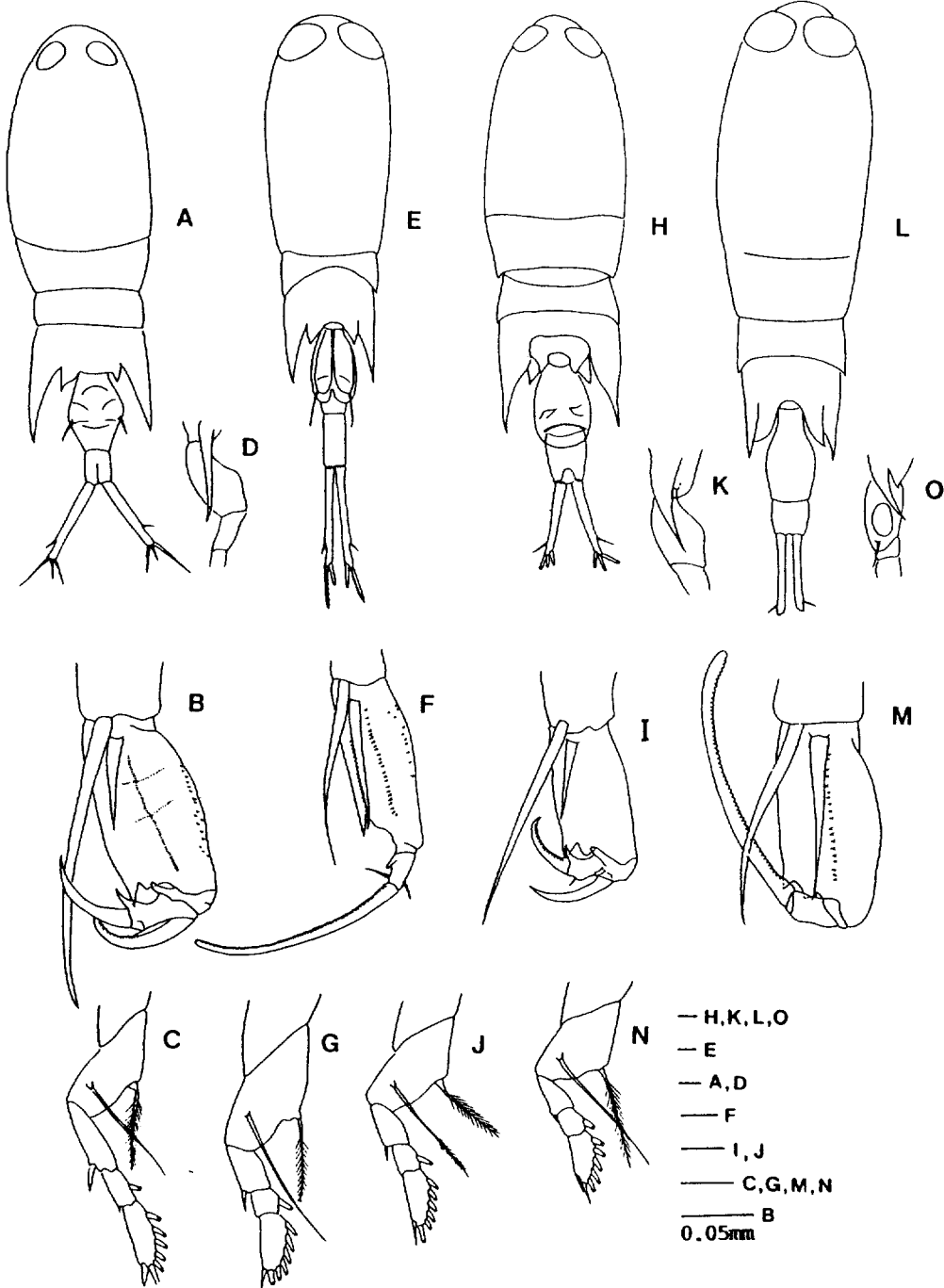


Plate 1. Figs. A-D.: *Corycaeus (Corycaeus) speciosus* (F.): A. dorsal view of body, B. 2nd antenna, C. 4th leg, D. lateral view of genital segment; Figs. E-G: *C. (C.) speciosus* (M.): E. dorsal view of body, F. 2nd antenna, G. 4th leg; Figs. H-K: *C. (C.) crassiusculus* (F.): H. dorsal view of body, I. 2nd antenna, J. 4th leg, K. lateral view of genital segment; Figs. L-O: *C. (C.) crassiusculus* (M.): L. dorsal view of body, M. 2nd antenna, N. 4th leg, O. lateral view of genital segment (Scale unit = 0.05 mm).

PLATE 2

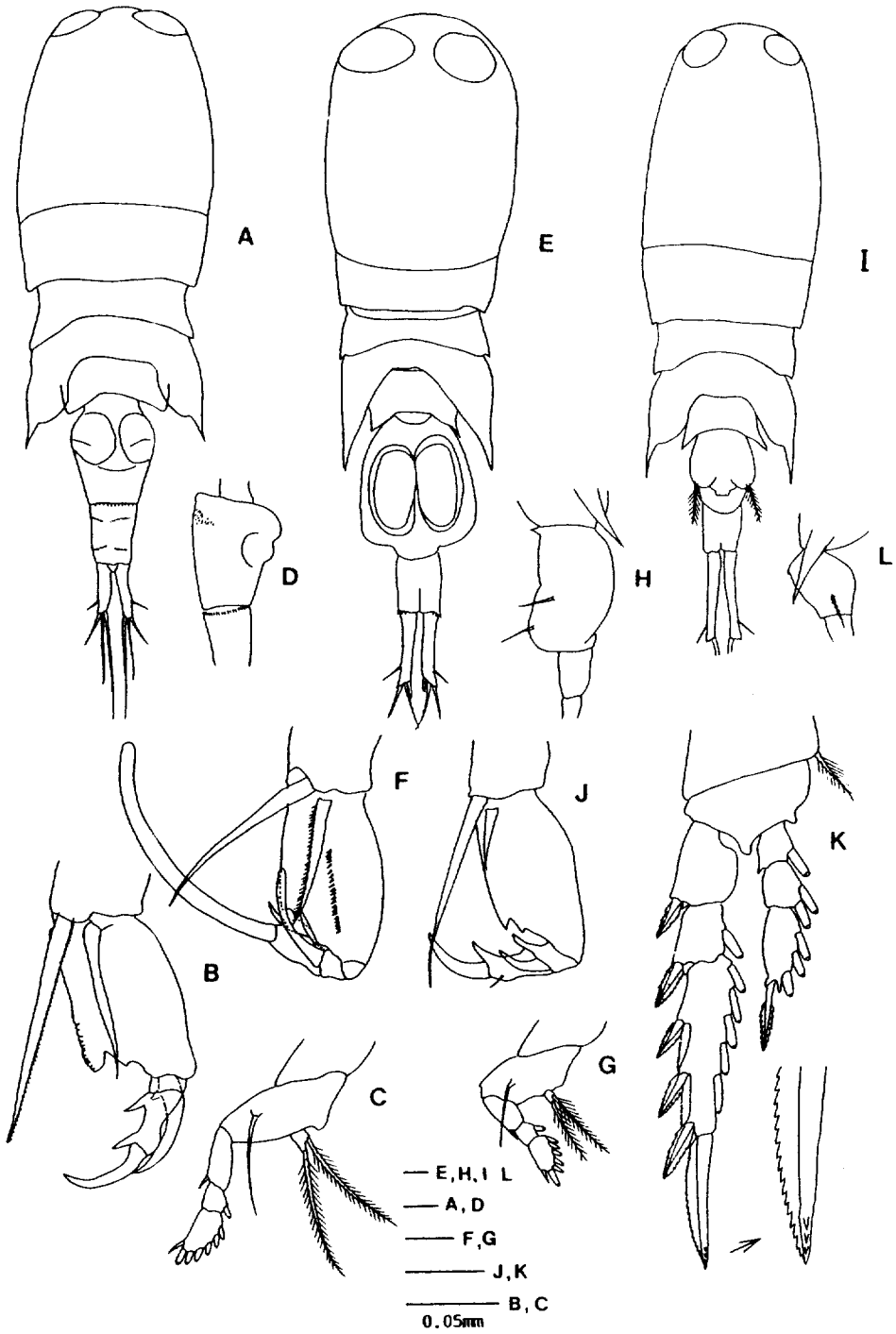


Plate 2. Figs. A-D: *Corycaeus(D.) andrewsi(F.)*: A. dorsal view of body, B. 2nd antenna, C. 4th leg, D. lateral view of genital segment; Figs. E-H: *C.(D.) andrewsi(M.)*: E. dorsal view of body, F. 2nd antenna, G. 4th leg, H. lateral view of genital segment; Figs. I-L: *C.(D.) erythraeus(F.)*: I. dorsal view of body, J. 2nd antenna, K. 2nd leg, L. lateral view of genital segment (Scale unit = 0.05 mm).

PLATE 3

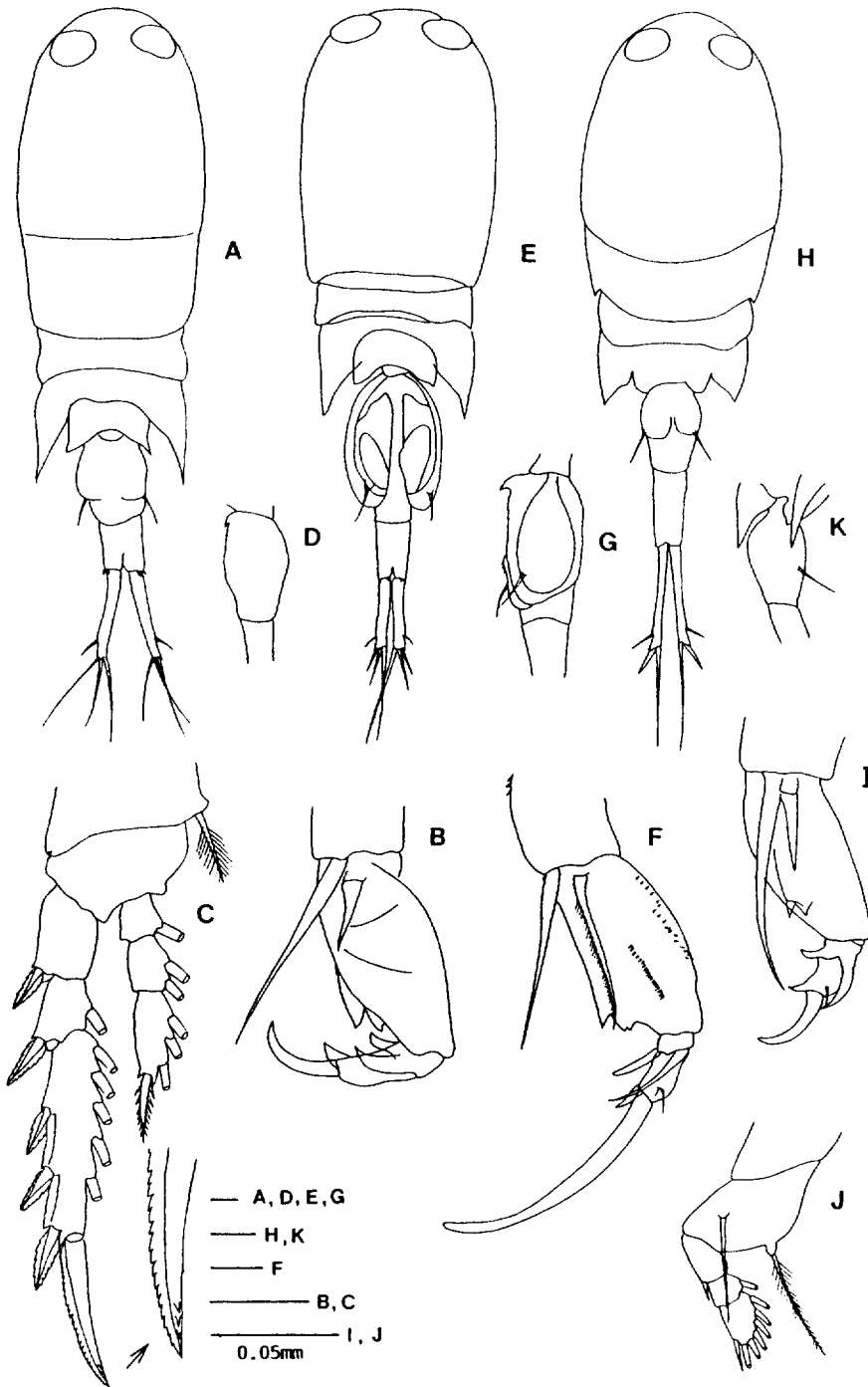


Plate 3. Figs. A-D: *Corycaeus(D.) affinis(F.)*: A. dorsal view of body, B. 2nd antenna, C. 2nd leg, D. lateral view of genital segment; Figs. E-G.: *C.(D.) affinis(M.)*: E. dorsal view of body, F. 2nd antenna, G. lateral view of genital segment; Figs. H-K.: *C.(Dnychocorycaeus) agilis(F.)*: H. dorsal view of body, I. 2nd antenna, J. 4th leg, K. lateral view of genital segment (Scale unit=0.05 mm).

PLATE 4

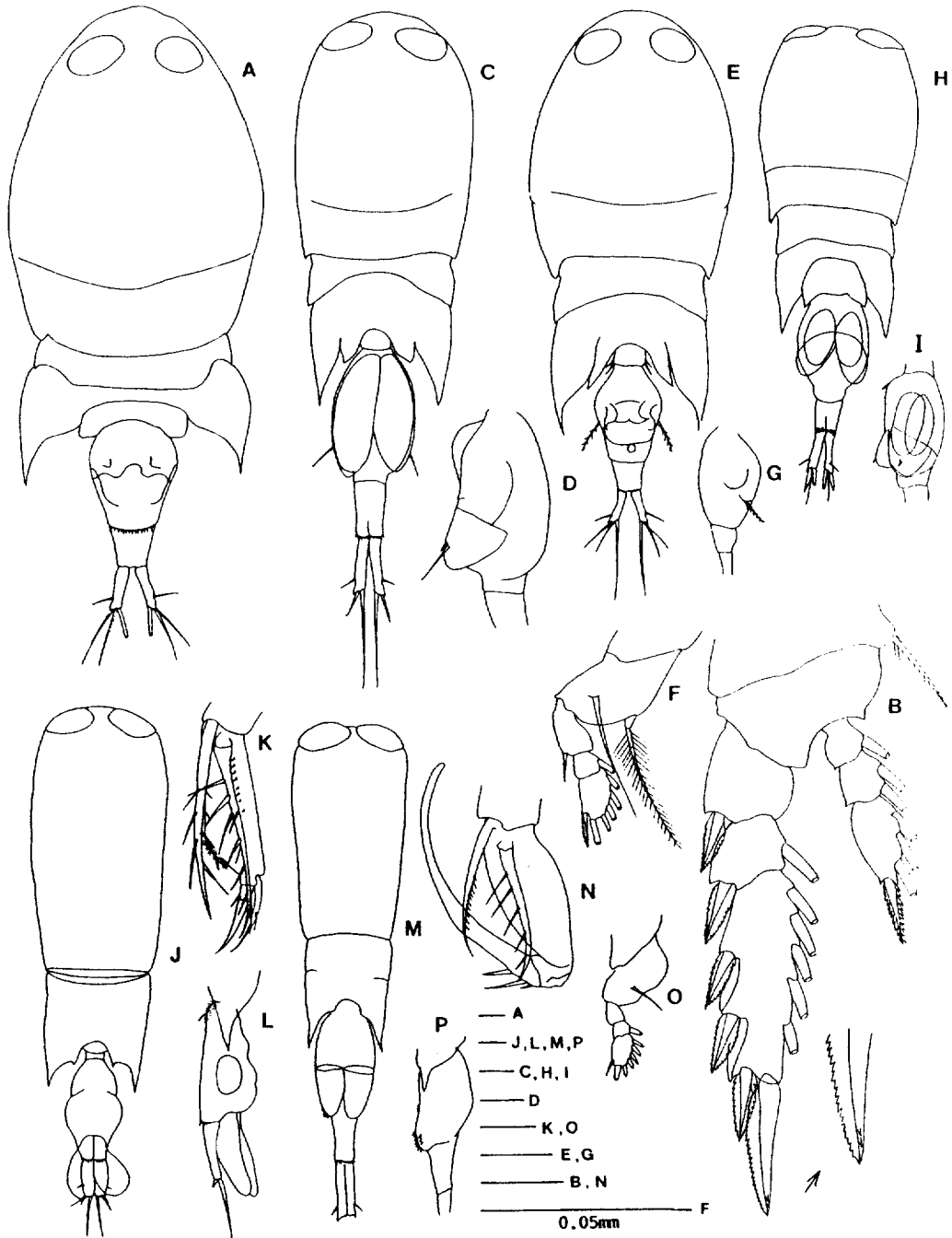


Plate 4. Figs. A, B: *Corycaeus*(*O.*) *pacificus*(*F.*): A. dorsal view of body, B. 3rd leg; Figs. C, D: *C.*(*O.*) *pacificus*(*M.*): C. dorsal view of body, D. lateral view of genital segment; Figs. E-G: *C.*(*O.*) *catus*(*F.*): E. dorsal view of body, F. 4th leg, G. lateral view of genital segment; Figs. J-L: *Farranula gibbula*(*F.*): J. dorsal view of body, K. 2nd antenna, L. lateral view of genital segment; Figs. M-P: *F. gibbula*(*M.*): M. dorsal view of body, N. 2nd antenna, 0.4th leg, P. lateral view of genital segment (Scale unit = 0.05 mm).