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한국산 양식어류에 기생하는 *Caligus* (Siphonostomatoida, Copepoda) 2종

최상덕* · 홍성윤** · 이종문***

Two Species of *Caligus* (Siphonostomatoida, Copepoda) Parasitic on Marine Cultured Fishes from Kamak Bay in Korea

Sang Duk CHOI*, Sung Yun HONG** and Jong Mun LEE***

Two species of the copepod parasite were collected from two Korean cultured fishes, *Lateolabrax japonicus* Cuvier and Valenciennes and *Paralichthys olivaceus* Temminck and Schlegel taken from Kamak Bay, Korea. It contains redescription of two species of *Caligus* (Siphonostomatoida, Caligidae). Both species, *C. pelamydis* Kroyer and *C. brevicaudatus* A. Scott, are newly recorded from the Korean water. We report *L. japonicus* and *P. olivaceus* are the additional host of *C. pelamydis* and *C. brevicaudatus* respectively.

요 약

한국산 양식어류 2종 (농어, 넙치)으로부터 기생성 요각류 2종이 채집되었다. 이 곳에 *Caligus* (Siphonostomatoida, Caligidae) 속의 2종 (*C. pelamydis* Kroyer, *C. brevicaudatus* A. Scott)을 재기재한다. 이들은 모두 한국 미기록종이며, 농어는 *C. pelamydis*, 넙치는 *C. brevicaudatus*의 새로운 숙주이다.

Introduction

Copepod parasites are known as harmful organisms of fishes (Kabata, 1979; Suh et al., 1993) and bivalves (Wilson, 1938; Dinamani and Gordon, 1974; Davey and Gee, 1976; Paul, 1983; Pregonzer, 1983, Choi and Suh, 1991), which can cause serious economic damage in mariculturing farms. In Korean waters, nevertheless, few studies have been done on copepod parasites of marine cultured fishes, although copepod parasites of marine animal hosts have received the attention of carcinologists (Suh and Choi, 1990, 1991; Suh et al., 1992; Kim, 1992; Kim and Ho, 1991; Ho and Kim, 1992), ecologists (Choi and Suh, 1991; Suh et al., 1993).

In order to add complete our knowledge of the pathogenic agents of Korean cultured fishes, two years-round survey of the pathogenic agents of Korean cultured fishes was carried out. By the way, we had an opportunity to examine specimens of the mortalities of marine cultured fishes occurred on Kamak bay in Korea. Having studied this material, we recovered two species of the copepod parasite from two species of Korean cultured fishes;

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Caligus pelamydis Kroyer from *Lateolabrax japonicus* Cuvier and Valenciennes, *C. brevicaudatus* A. Scott from *Paralichthys olivaceus* Temminck and Schlegel in Korean waters. Both species of copepod parasites treated herein are reported for the first time to the Korean fauna.

Materials and Methods

The fishes examined for the copepod parasites were taken from cultured area in Kamak Bay, Yosu (34° 42'N, 127° 43' E). All fishes were collected with hand. We have removed the copepod parasites from the gill of fishes. After collection, all copepod parasites were fixed and preserved in 5% buffered formalin-seawater. In studying morphology, copepods were cleared in lactic acid and dissected on wooden slides (Humes and Gooding, 1964). Body length was measured from anterior margin of prosome to posterior margin of abdomen.

Drawings were made with the aid of a drawing tube. Body structures are described according to the terminology of Kabata (1979).

Results and Discussion

Order Siphonostomatoidea Thorell, 1859

Family Caligidae Wilson, 1905

Caligus pelamydis Kroyer, 1863

Caligus pelamydis Kroyer, 1863, p. 75-320; Bassett-Smith, 1896a, p. 8-16; Bassett-Smith, 1896b, p. 155-163; Scott, T., 1901, p. 120-153; Baxshal, 1974, p. 355-372.

MATERIAL EXAMINED. We have removed 20 ♀ specimens of copepod parasites from the gill of 3 fishes, *Lateolabrax japonicus* Cuvier and Valenciennes which were taken from cultured area in Kamak Bay, 7 October 1993.

DESCRIPTION. Female; Body length, 2.38~2.99mm (mean=2.66, n=6).

Cephalothorax (Fig. 1A) wider than long and measuring 1.04mm (0.97~1.12mm) × 1.21mm (1.15~1.29mm), orbicular; Frontal plates indented centrally.

Fourth leg-bearing segment short, 0.19mm (0.17~0.22mm) long by 0.32mm (0.27~0.37mm) wide, indistinctly divided from genital complex. Genital complex (Figs. 1A, 3G); rounded, slightly wider than long 0.81mm (0.71~0.92mm) × 0.97mm (0.90~1.12mm). Area of egg sac attachment (Figs. 1A, 3G) located posterior margin of genital complex. Egg sacs (Fig. 1A) 1.66mm (1.59~1.73mm) long, each containing 18~20 eggs. Division between genital complex and abdomen indistinct. Abdomen (Figs. 1A, 2D) narrow and indistinctly two-segmented, 0.54mm (0.47~0.63mm) × 0.28mm (0.24~0.33mm). Caudal ramus (Figs. 1A, 2D) longer than wide, 0.10mm (0.08~0.10mm) × 0.08mm (0.06~0.08mm), with 6 setae.

First antenna (Fig. 1B) two-segmented; robust basal segment bearing 27 setae on the anterior margin, terminal segment with 12 setae. Lunules (Fig. 1C) small, 0.08mm (0.08~0.09mm) in diameter. Second antenna (Fig. 1D) four-segmented, hamate; small basal segment short and unarmed; second segment with prominent

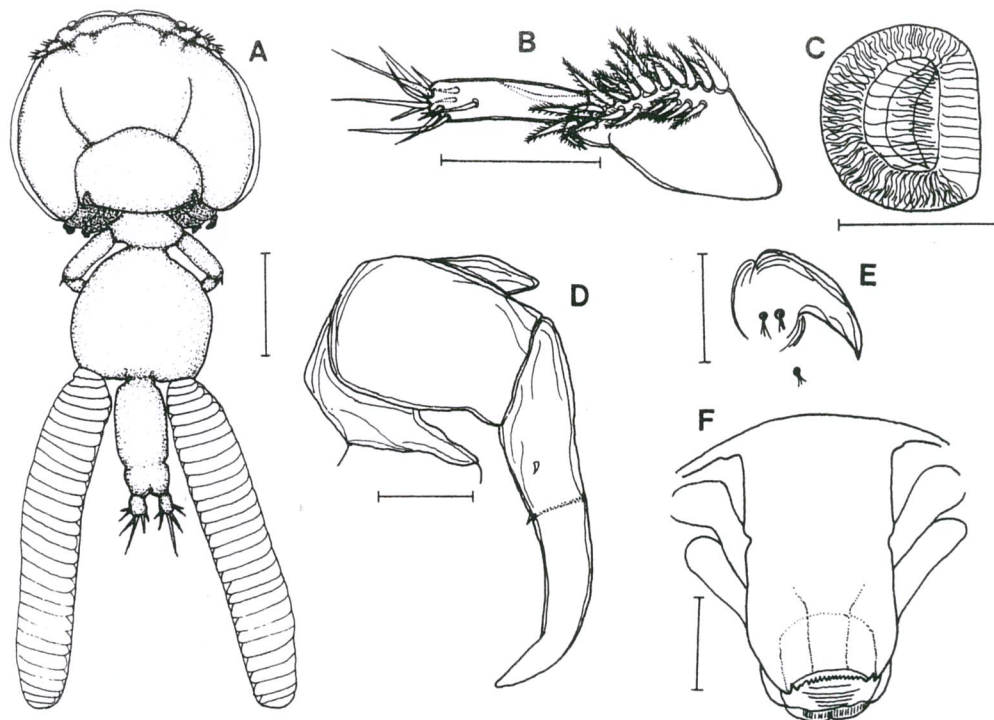


Fig. 1. *Caligus pelamydis* Kroyer. Female: A, habitus, dorsal; B, first antenna; C, lunule; D, second antenna; E, postantennary process; F, mouth cone. Scale bar: A=1mm; B-F=0.1mm.

process; terminal segment simple process like claw is partially fused by two-segmented, with 2 setae on the first segment.

Postantennary process (Fig. 1E) well developed, very short, mildly curved. Mouth cone (Fig. 1F) short, blunt, labrum with notched margins at about midlength.

Mandible (Fig. 2A) a piston-like rod, consisting of four parts, possibly corresponding to four segments. The first three are circular in cross-section, flatform terminal segment with 13 denticles on inner margin.

First maxilla of two parts (Fig. 2B), separated from each other; close to, but separate from, the base is a papilliform outgrowth surmounted by 3 setae; dentiform process with narrow base, long and slender, without secondary processes or sculpturing, mildly curved. Second maxilla (Fig. 2C) two-segmented; calamus about 2 times as long as canna; canna doubly edged with serrated rim. Maxilliped (Fig. 2E) three-segmented; first segment long and unarmed; subchela long, with very long, slender claw, poorly delimited from shaft, with short barbel at base. Sternal furca (Fig. 2F) with almost parallel tines, 0.12mm (0.11~0.13mm) × 0.07mm (0.06~0.08mm); tines as long as box, covering, with narrow, indistinct flanges on lateral margin.

First leg (Figs. 3A, B, C) two-segmented sympod, its segments overlapping. Endopod vestigial, with very small, papilliform outgrowth. Two segmented exopod robust, longer than the sympod. Basal segment, much larger than the terminal, with a small seta on posterior margin. Terminal segment with 4 setae on distal margin, overlapping one another; seta 1 longer than other three; with slender tip; setae 2 and 3 about equally long, their

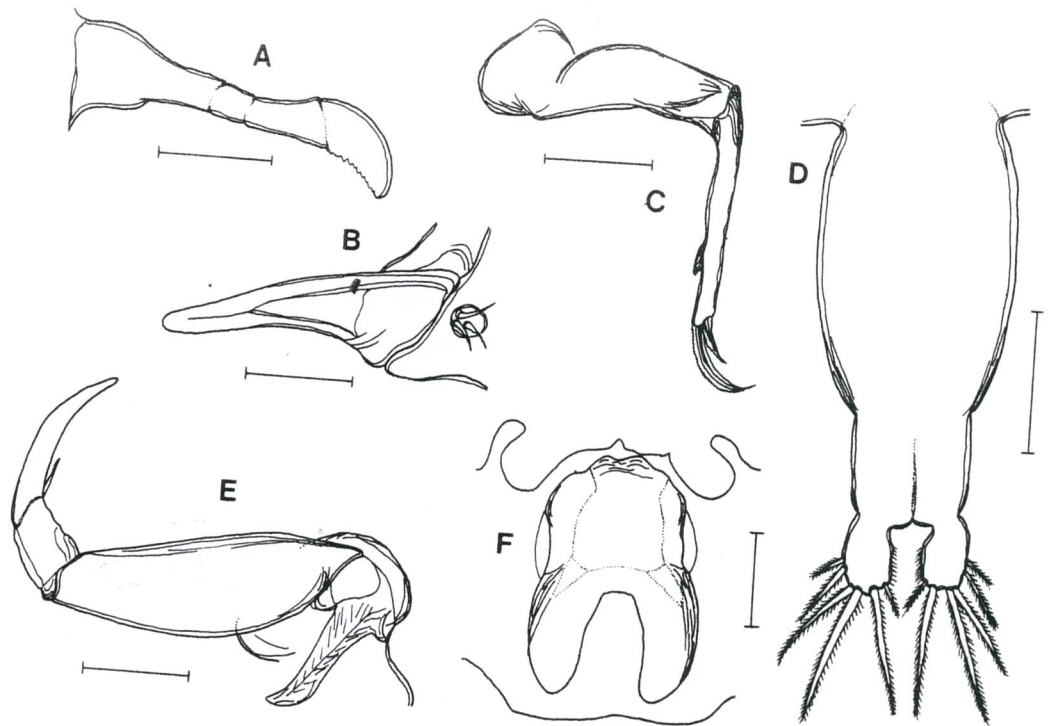


Fig. 2. *Caligus pelamydis* Kroyer. Female: A, mandible; B, first maxilla; C, second maxilla; D, maxilliped; E, sternal furca; F, caudal ramus. Scale bar: A=0.05mm; B,E=0.1mm; C,D,F=0.2mm.

distal parts with 2 rows of denticles along margins; seta 4 with only one of denticles rather longer than those of other setae; three large, long pinnate setae on the posterior margin. Second leg (Fig. 3D) with both rami well developed, three-segmented. Endopod with patches of short, bristle-like setules along lateral side of ventral surface on the second and third segment; no bristles on first segment. Third leg (Fig. 3E) typical for family. Fourth leg (Fig. 3F) four-segmented, with 3 apical setae; all setae of similar length, all with basal pectens; anterior margins of all setae bearing strip of serrated membrane, posterior bearing several rows of densely crowded setules. Fifth leg (Fig. 3G) vestigial, with 4 setae, three together and one further apart, located on posterolateral corner of genital complex.

Remarks. The original description of this species was made by Kroyer (1863).

The Korean specimens show no significant difference from his description except difference in the body length. Total length of the present species (2.4~3.0mm) is much smaller than those of the former (3.0~5.5mm). *Caligus pelamydis* is easily identified by body shape, postantennary process, sternal furca, first and fourth leg. Like other species which include among their hosts large scombrid fishes, *C. pelamydis* is very widespread, having been reported from many parts of the world in about 15 species of fishes. We report the additional host, *Lateolabrax japonicus* Cuvier and Valenciennes, taken from cultured area in Kamak Bay, Korea.

Order Siphonostomatoidea Thorell, 1859

Family Caligidae Wilson, 1905

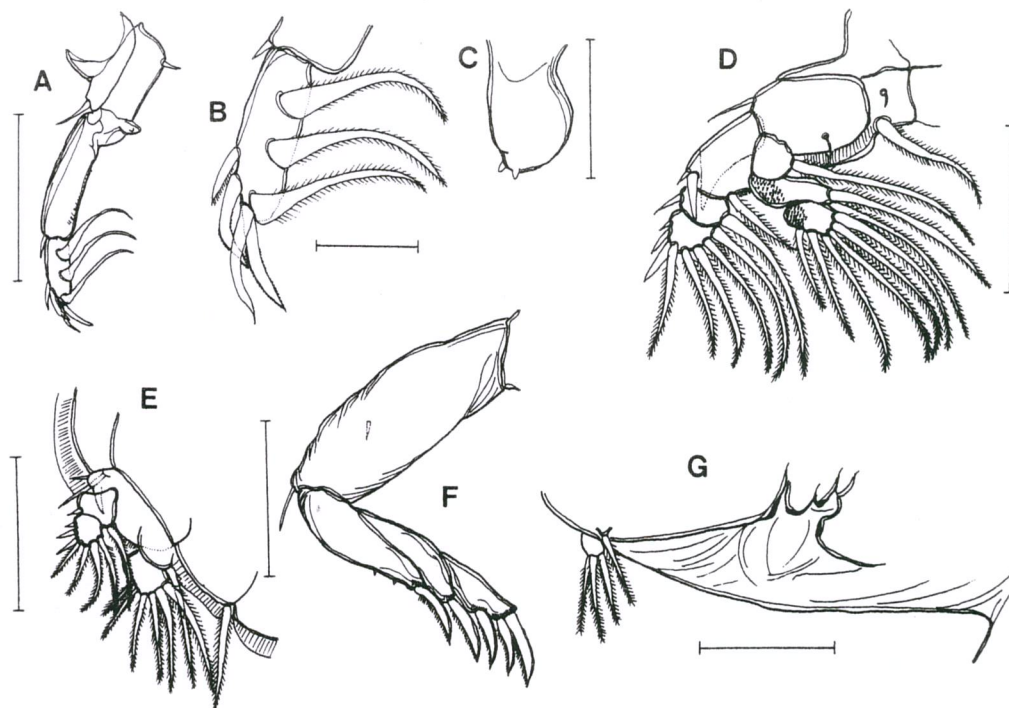


Fig. 3. *Caligus pelamydis* Kroyer. Female: A, first leg; B, tip of first exopod; C, second leg; D, third leg; E, fourth leg; F, posterolateral corner of genital complex. Scale bar: A, C, D-E=0.2mm; B=0.1mm.

Caligus brevicaudatus A. Scott, 1901

Caligus brevicaudatus A. Scott, 1901, p. 342-353; Reichenbach-Klinke, 1956, p. 115-126; Scott and Scott, 1913, pp. 1-257, 72 plates.

MATERIAL EXAMINED. We have removed 16 ♀ specimens of copepod parasites from the gill of 4 fish, *Paralichthys olivaceus* Temminck and Schlegel were taken from cultured area in Kamak Bay, 7 October 1993.

DESCRIPTION. Female; Body length, 3.83~4.35mm (mean=4.06, n=5). Cephalothorax (Fig. 4A) longer than wide and measuring 2.62mm (2.45~2.84mm) × 2.49mm (2.43~2.61mm), suborbicular, with slightly narrower anterior end; Frontal plates indented centrally. Fourth leg-bearing segment short, 0.21mm (0.16~0.25mm) long by 0.52mm (0.51~0.53mm) wide, distinctly divided from genital complex. Genital complex (Figs. 4A, 6F); slightly wider than long 0.93mm (0.90~0.96mm) × 1.31mm (1.23~1.37mm), anterolateral corners rounded, posterolateral small, rounded lobes; lateral margins of genital complex with very small, but clearly noticeable, setae, about 6~11 on each margin. Area of egg sac attachment (Figs. 4A, 6F) located posterior margin of genital complex. Egg sacs (Fig. 4A) 1.68mm (1.27~2.21mm) long, each containing 19~27 eggs. Anterior of abdomen pushed into, but delimited from, genital complex. Abdomen (Fig. 4A) one-segmented, broader than long 0.16mm (0.15~0.16mm) × 0.41mm (0.39~0.43mm). Caudal ramus (Figs. 4A, 5F) slightly longer than wide, 0.14mm (0.13~0.15mm) × 0.13mm (0.12~0.14mm), with 6 setae.

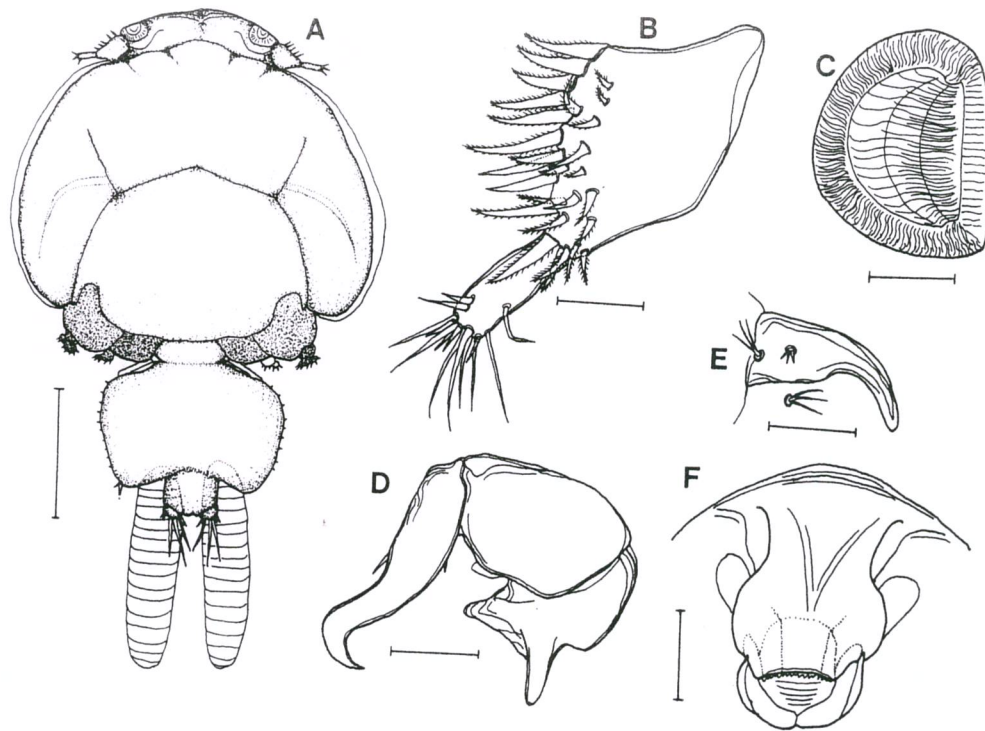


Fig. 4. *Caligus brevicaudatus* A. Scott. Female: Female: A, habitus, dorsal; B, first antenna; C, lunule; D, second antenna; E, postantennary process; F, mouth cone. Scale bar: A=0.5mm; B-C=0.1mm; D-F=0.05mm.

First antenna (Fig. 4B) two-segmented; robust basal segment bearing 27 setae on the anterior margin, terminal segment with 14 setae. Lunules (Fig. 4C) developed, 0.27mm (0.24~0.25mm) in diameter. Second antenna (Fig. 4D) three-segmented, hamate; small basal segment short and unarmed; second segment with prominent process; terminal segment simple process like claw is fully fused by two-segmented, with 2 setae on the inner and outer mid-parts.

Postantennary process (Fig. 4E) well developed, short, mildly curved; close to, but separate from, the base is a papilliform outgrowth surmounted by three or 4 atypical setae; 3 papilliforms on posterolateral of postantennary process. Mouth cone (Fig. 4F) short, blunt, labrum with notched margins at about midlength.

Mandible (Fig. 5A) a piston-like rod, consisting of four parts, possibly corresponding to four segments. The first three are circular in cross-section, flatform terminal segment with 13 denticles on inner margin.

First maxilla of two parts (Fig. 5B), separated from each other; close to, but separate from, the base is a papilliform outgrowth surmounted by 3 setae; dentiform process with narrow base, long and slender, without secondary processes or sculpturing. Second maxilla (Fig. 5C) two-segmented, brachiform; calamus about 2 times as long as canna; canna doubly edged with serrated rim.

Maxilliped (Fig. 5D) three-segmented; first segment long, robust and unarmed; subchela with a claw, delimited from shaft, with short barbel at base; terminal claw of subchela short, slender and with sharp point. Sternal

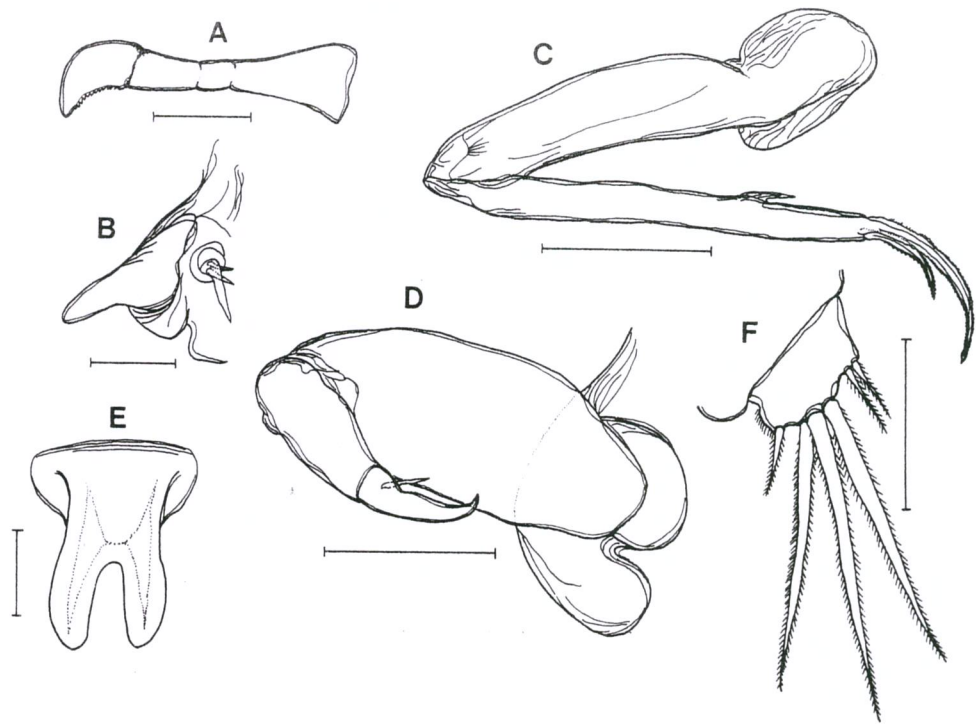


Fig. 5. *Caligus brevicaudatus* A. Scott. Female: A, mandible; B, first maxilla; C, second maxilla; D, abdomen; E, maxilliped; F, sternal furca. Scale bar: A,B,F=0.05mm; C,D-E=0.1mm.

furca (Fig. 5E) with square basal box, almost parallel tines, 0.25mm(0.23~0.28mm)long; tines not longer than box, slightly covering, blunt. First leg (Figs. 6A, B) two-segmented sympod, its segments overlapping. Endopod vestigial, with very small, papilliform outgrowth. Two segmented exopod robust, longer than the sympod. Basal segment, much larger than the terminal, with a small seta on posterior margin. Terminal segment with 4 setae on distal margin, overlapping one another; seta 1 robust, tapering, longer than other three; setae 2 and 3 about equally long, with spiniform secondary processes equalling 1/2 length of setae; their anterior parts with a row of serrated flanges along margins; seta 4 simple, robust, with only one row of serrated; posterior margin of segment with 3 large, long pinnate setae.

Second leg (Fig. 6C) with both rami well developed, three-segmented; endopod with fringe of fine setules on lateral margins of all three segments. Third leg (Fig. 6D) typical for family. Fourth leg (Fig. 6E) three-segmented, with distal tip of sympod bearing one long and pinnate seta and one short multiple setule; exopod two-segmented; distal segment armed with three apical setae, gradually diminishing in length; two margins of all setae bearing strip of serrated membrane; first seta longer than others, with basal pectens; third seta of distal segment similar to apical seta of basal. Fifth leg (Fig. 6F) vestigial, with three setae, two together and one further apart, located on posterolateral corner of genital complex.

Remarks. *Caligus brevicaudatus* is easily identified by body shape, genital complex, sternal furca, first and fourth

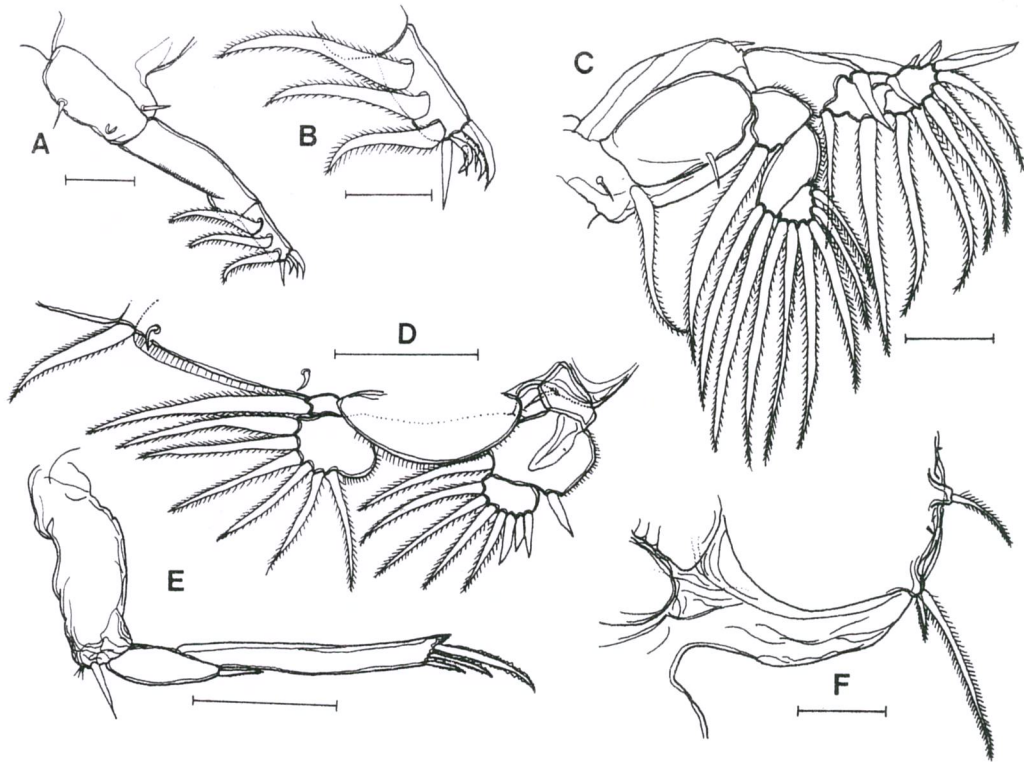


Fig. 6. *Caligus brevicaudatus* A. Scott. Female: A, first leg; B, tip of first exopod; C, first endopod; D, second leg; E, third leg; F, fourth leg; G, posterolateral corner of genital complex. Scale bar: A,D,E-F=0.2mm; B-C=0.05mm; G=0.1mm.

leg. The present species show no significant difference from Scott's original description (1901) except difference in the body length. Total length of the present species (3.8~4.4mm) is smaller than those of the former (5.0mm), of which genital complex is broader than long. This species is rare in Scottish waters, the North and Irish Seas (Kabata, 1979). But we have obtained 16 ♀ specimens of copepod parasites from the gill of 4 fish, *Paralichthys olivaceus* Temminck and Schlegel were taken from cultured area in Kamak Bay, Korea. Its host had been reported from the Irish Seas in about 4 species of fishes. We report the additional host, *Paralichthys olivaceus* Temminck and Schlegel.

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