

Three Species of *Caligus* (Copepoda: Caligidae) Parasitic on Fishes of the Northeast Coast of Taiwan

Ju-shey Ho¹ and Ching-Long Lin^{2*}

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ABSTRACT

Three species of sea lice belonging to the genus *Caligus* (Copepoda, Caligidae) were recovered from three species of marine food fishes landed at Da-Hsi Fishing Port located on the northeast coast of Taiwan. They are: *C. amblygenitalis* Pillai, 1961 from *Mene maculata* (Bloch & Schneider); *C. equulae* n. sp. from *Carangoides equula* (Temminck & Schlegel); and *C. patulus* Wilson, 1937 from *Chanos chanos* (Forsskål). This is the first report of *C. amblygenitalis* outside of its type-locality – Vizhingom, India. The new species *C. equulae* is close to *C. confuses* Pillai, 1961 and *C. cordyla* Pillai, 1963 occurring in the waters of Taiwan. However, it is distinguishable from them by having three protuberances in myxal region of the corpus of the maxilliped and three small and short (instead of large and long) plumose setae on the posterior margin of the terminal segment of leg 1 exopod. The third species *C. patulus* is new to Taiwan.

Key words: sea lice, Caligidae, *Caligus*, parasitic copepods, marine fishes, Taiwan

INTRODUCTION

Da-Hsi in I-Lan County is one of the major fishing ports in Taiwan. It is located on the northeast coast of the island facing the Pacific Ocean. Although we have been studying parasitic copepods of marine food fishes since August, 1997 (Ho *et al.*, 2000), the effort has so far been restricted to the fishes of the west coast taken from the Strait of Taiwan. Thus, in order to understand the total copepod parasite fauna of the fishes of Taiwan, we started in the beginning of this year to examine fishes landed at Da-Hsi Fishing Port. This is the first report of the attempt. It covers three species of *Caligus*, which is the largest genus of the parasitic copepods. While one of the three species to be reported is new to science,

C. amblygenitalis Pillai, 1961 is to be reported for the first time out side of its type-locality – Vizhingom, India, and the third species, *C. patulus* Wilson, 1937 is new to Taiwan.

MATERIALS AND METHODS

Host fishes landed at Da-Hsi Fishing Port of I-Lan County were purchased, kept in an ice-box, and transported to the laboratory of the Crab Museum in Da-Hsi of I-Lan County for examination of the copepod parasites. The parasites removed from the fish hosts were preserved in 70% ethanol. They were later cleared in 85% lactic acid for 1 to 2 hours before making dissection in a drop of lactic acid on a wooden slide under the dissection microscope (Humes and Gooding, 1964). The removed body parts and appendages

¹ Department of Biological Sciences, California State University, Long Beach, California 90840-3702, USA

² Department of Aquacitic Biosciences, National Chiayi University, Chiayi, 60083, Taiwan

*Corresponding author



were examined in a drop of lactic acid under the compound microscope with a series of magnification up to $\times 1,500$.

All drawings were made with the aid of a *camera lucida*. Measurements of the body and body parts were taken from 10 randomly selected specimens when more than that number of specimens was found in the collection. The various measurements given in the description are the average with its range shown in the parentheses that follow.

Identification of the fishes was based on the information provided in Shen (1993) and Shao (1996). Scientific names as well as the common names of the host fishes followed those adopted in Froese and Pauly (2002).

RESULTS

Order Siphonostomatoida Thorell, 1859

Family Caligidae Burmeister, 1834

Genus *Caligus* Müller, 1785

Caligus amblygenitalis Pillai, 1961
(Figs. 1, 2)

Material examined: 1 ♀ in gill cavity of a moonfish, *Mene maculata* (Bloch & Schneider), landed at Da-Hsi Fishing Port of I-Lan County on 27 June 2002.

Female: Body (Fig. 1A) 4.14 mm, long, excluding setae on caudal rami. Cephalothoracic shield slightly longer than wide, 1.88 x 1.56 mm, excluding marginal membranes. Fourth pediger 2.6 times wider than long, 0.16 x 0.42 mm. Genital complex with broadly round protruded posterolateral region, 1.50 x 1.02 mm. Abdomen longer than wide, 0.64 x 0.34 mm. Caudal ramus (Fig. 2G) attached to abdomen diagonally with outer edge 1.59 times longer than medial edge; segment proper more than twice as long as wide, 0.20 x 0.08 mm, and armed with 3 short and 3 very long plumose setae in addition to a row of setules on distal part of medial margin. Egg sac short, 1.66 mm long, and carrying only 17 eggs.

Antennule (Fig. 1B) 2-segmented; proximal segment distinctly longer than distal segment and armed with 27

plumose and 2 simple setae on anterodistal surface; distal segment armed with 1 subterminal seta on posterior margin and 11 setae plus 2 aesthetascs on distal margin. Antenna (Fig. 1C) 3-segmented; proximal segment smallest, with sharply pointed posteromedial process; middle segment largest but unarmed; distal segment a claw with robust seta in basal region and slender seta in middle region. Basal part of postantennal process (Fig. 1C) carrying 2 papillae with each bearing single setule, another similar but isolated papilla on nearby sternum. Mandible (Fig. 1D) 4-segmented; with 12 teeth on medial margin of distal blade. Maxillule (Fig. 1C) comprising bluntly pointed dentiform process and basal papilla armed with 3 naked setae. Postmaxillary process present (Fig. 1C). Maxilla (Fig. 1E) 2-segmented; proximal segment (lacertus) unarmed; slender distal segment (brachium) with finely serrated membrane on medial margin of distal half in addition to carrying subterminal hyaline membrane on outer edge and 2 unequal, terminal elements, short canna and long calamus. Maxilliped (Fig. 1F) with large, long, corpus bearing 2 protrusions in basal region; subchela about one-half length of corpus; terminal claw shorter than shaft, former with long basal seta and latter with small subterminal barbell. Sternal furca (Fig. 1G) with 2 blunt-tip divergent tines fringed with narrow hyaline membrane.

Armature of rami of legs 1-4 (Figs. 2A-E) as follows (Roman numerals indicating spines and Arabic numerals, setae):

	Exopod	Endopod
Leg 1	1-0; III,1,3	(vestigial)
Leg 2	I-1; I-1; II,1,5	0-1; 0-2; 6
Leg 3	I-0; I-1; III,4	0-1; 6
Leg 4	I-0; III	(absent)

Coxa of Leg 1 (Fig. 2A) with long ventral setule close to outer margin; basis with outer and inner plumose seta in addition to a large patch of spinules on ventral surface; vestigial endopod tiny and



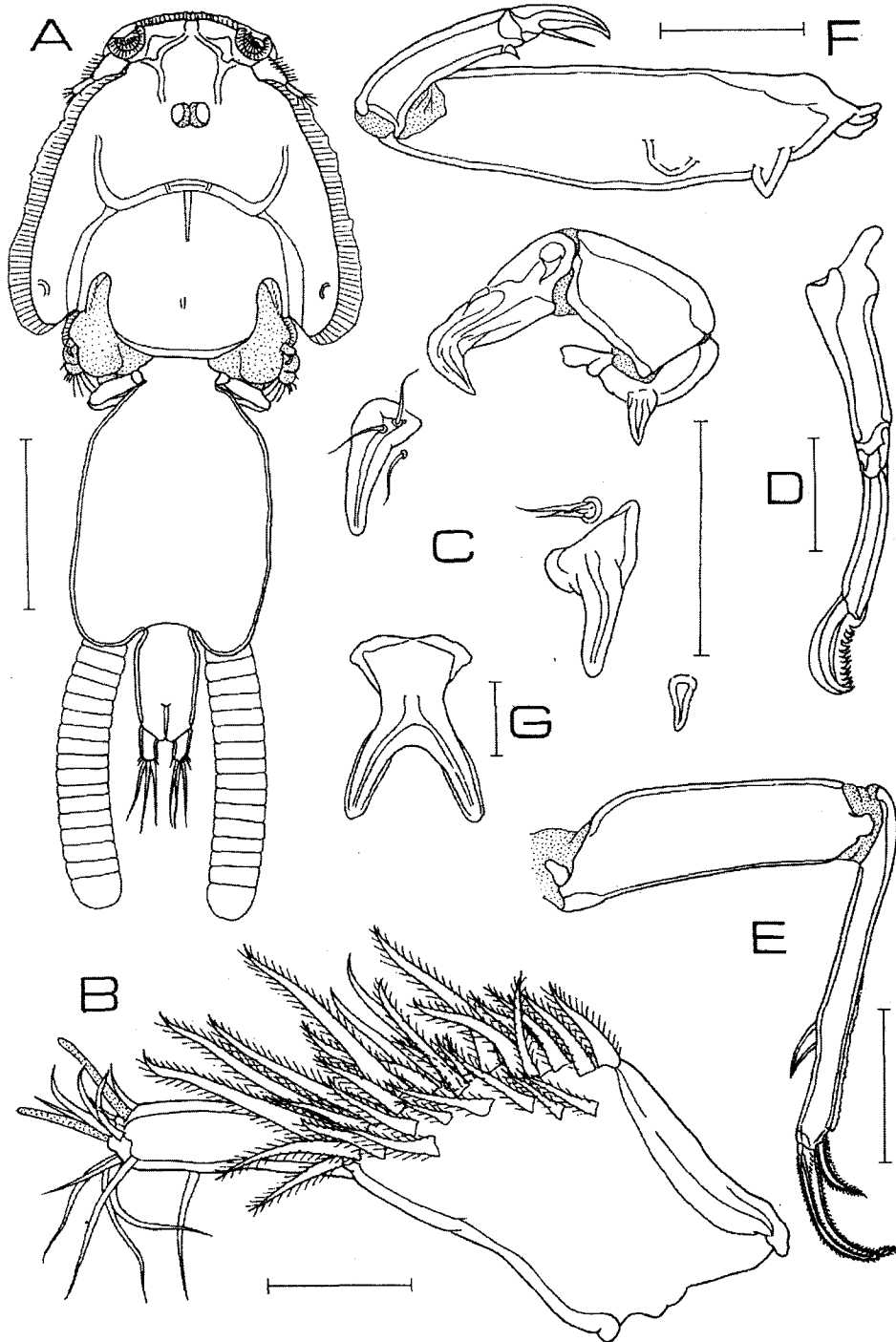


Fig. 1. *Caligus amblygenitalis* Pillai, female. A: habitus, dorsal; B: antennule, ventral; C: antenna, postantennal process, and maxillule, ventral; D: mandible; E: maxilla; F: maxilliped; G: sternal furca. Scale bars: 1 mm in A; 0.08 mm in B; 0.25 mm in C; 0.05 mm in D; 0.1 mm in E, F, G.



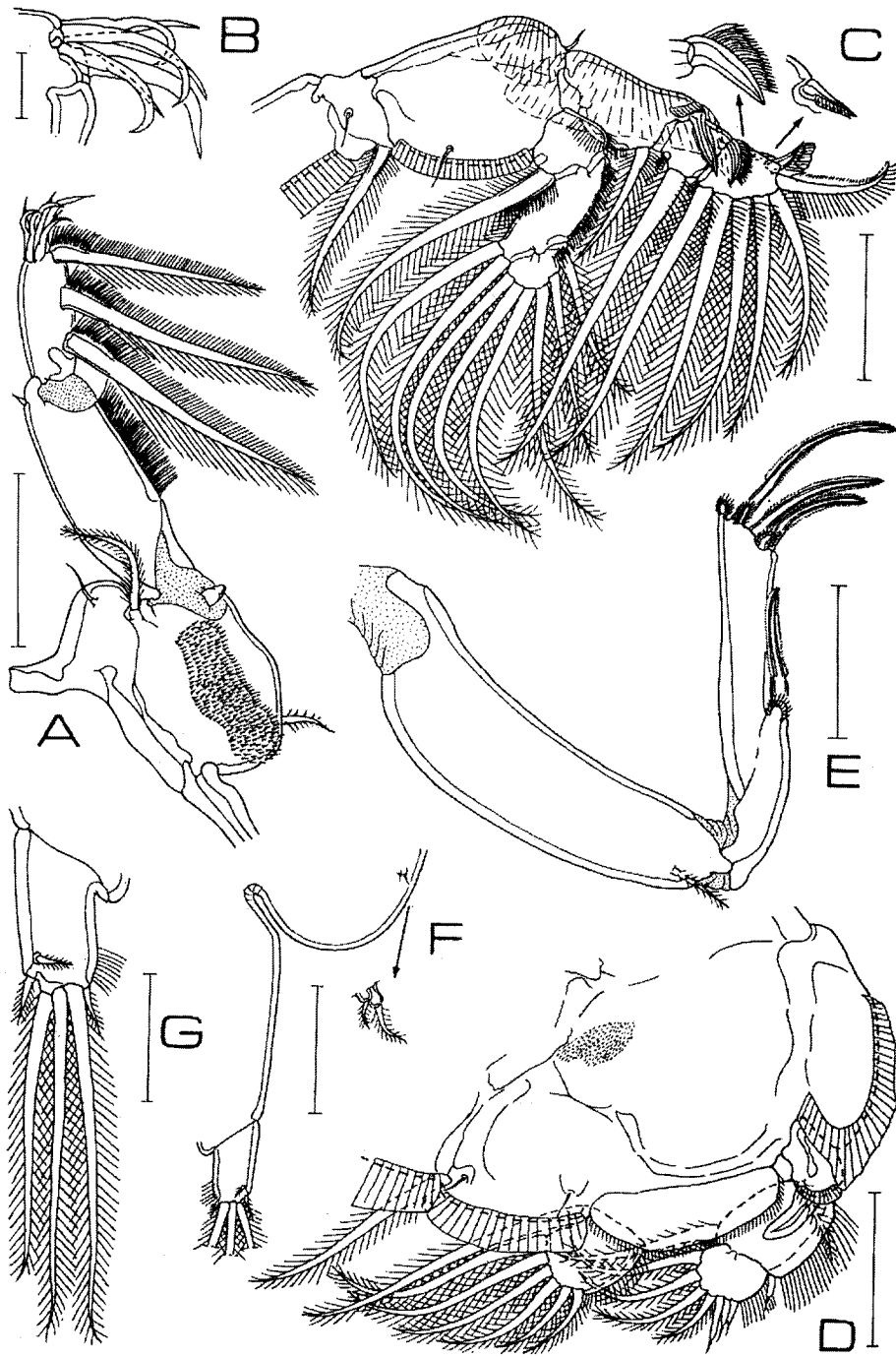


Fig. 2. *Caligus amblygenitalis* Pillai, female. A: leg 1, ventral; B: enlarged tip of leg 1 exopod; C: leg 2, ventral; D: leg 3, ventral; E: leg 4, ventral; F: left side of posterior part of body showing leg 5, ventral; G: caudal ramus, ventral. Scale bars: 0.15 mm in A, E, G; 0.25 mm in B; 0.2 mm in C, D; 0.3 mm in F.

unarmed; first segment of exopod with row of long setules on posterior edge and small, spiniform seta in anterodistal corner; outer 3 of 4 terminal elements on last segment of exopod with accessory process (Fig. 2B); 3 plumose setae on posterior surface of this segment large. Leg 2 (Fig. 2C) coxa small, with spinule bearing papilla on ventral surface and large, plumose inner seta on posterior edge; basis with small, naked outer seta in addition to a posterior, marginal setule on ventral surface and a long, narrow membrane on posterior margin; outer edges of both basis and first exopodal segment fringed with large marginal membrane; outer spine on middle segment of exopod unipectinate (see inserted, enlarged drawing). Proximal 2 outer spines on terminal segment of exopod bearing membrane on one side only (see inserted, enlarged drawing). Leg 3 (Fig. 2D) protopod (apron) armed with patch of fine spinules in central area, short, plumose, outer seta and long, plumose, inner seta in addition to a membrane on outer and another one on posterior edges; additionally, 2 marginal setules with each close to end of posterior membrane. Leg 4 (Fig. 2E) protopod with small, plumose outer seta; pectens on exopodal segments at insertion of each of 4 spines. Leg 5 (Fig. 2F) represented by 2 papillae, with each bearing 1 pinnate seta, located on posterolateral margin of genital complex.

Male: Not found.

Remarks: The most remarkable feature of the present species is in the possession of an accessory process on the outer three terminal elements located at the tip of the exopod of leg 1. In the great majority of *Caligus* species, only elements II and III carry an accessory process and element I is largely unarmed. So far as we are aware, in more than 250 species of *Caligus*, only three species share with *C. amblygenitalis* on this unusual character state. They are: *C. berychis* Wilson, 1936; *C. rufimaculatus* Wilson, 1905; and *C. sibogae* Boxshall &

Gurney, 1980. However, according to Cressey's (1991) redescription of *C. berychis* and *C. rufimaculatus* and Boxshall & Gurney's (1980) original description of *C. sibogae*, the present species is distinguishable from them by having a large patch of spinules on the ventral surface of the basis of leg 2 and an unipectinate outer spine with strong teeth on the second segment of the exopod of the same leg.

This is the second recording of *C. amblygenitalis*. It was first reported by Pillai (1961) from the body surface of a kawakawa [*Euthunnus affinis* (Cantor)] landed at Vizhingom in southern India. However, in his original description, the terminal element I on the exopod of leg 1 was not illustrated or described with an accessory process, and in his later treatment of the parasitic copepods of India (Pillai, 1985), no correction on this point was made. Nevertheless, we consider the absence of this feature in the original description of *C. amblygenitalis* is due to an oversight of the examiner. This assumption is supported when one considers the fact that Wilson (1905) did not mention nor illustrate in his original description of *C. rufimaculatus* the presence of an accessory process on the element I of leg 1 exopod, but Cressey (1991) found it on the lectotype and paralectotype of the species deposited in the National Museum of Natural History in Washington, D. C.

Caligus equulae n. sp.

(Figs. 3, 4, 5)

Material examined: All parasitic in gill cavities of whitefin trevallies, *Carangoides equula* (Temminck & Schlegel), landed at Da-Hsi Fishing Port of I-Lan County: 85 ♀♀, 6 ♂♂, and 2 female larvae obtained from 26 (out of 36 examined) host fishes collected on 1 June, 2002; and 51 ♀♀ and 2 ♂♂ removed from 13 host fishes collected on 28 June, 2002. One holotype female, 1 allotype male and 23 paratypes (20 ♀♀ and 3 ♂♂) were selected from the first collection and deposited in the National Museum of Natural History, Smith-



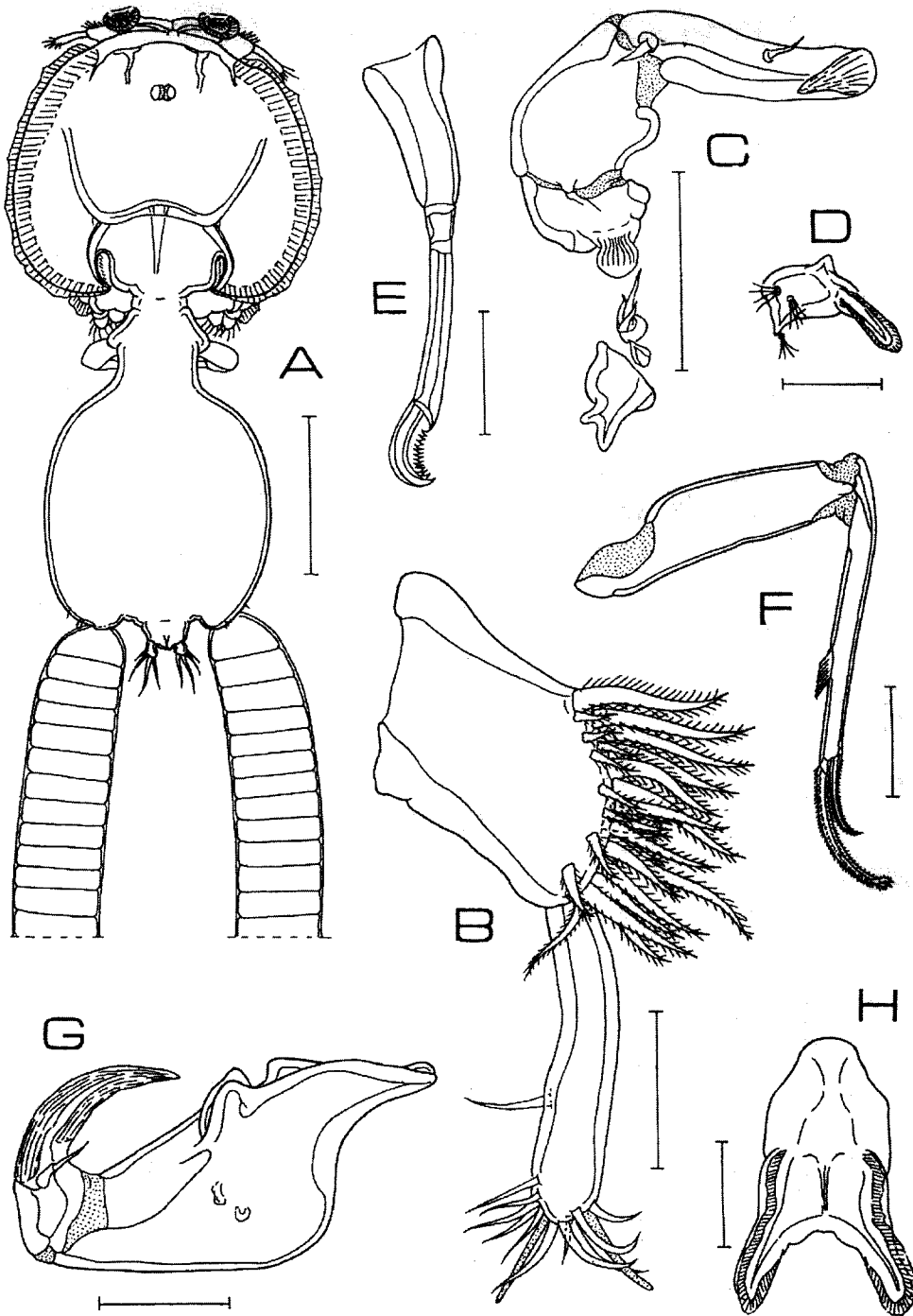


Fig. 3. *Caligus equulae* n. sp., female. A: habitus, dorsal; B: antennule, ventral; C: antenna and maxillule, ventral; D: postantennal process, ventral; E: mandible; F: maxilla; G: maxilliped; H: sternal furca, ventral. Scale bars: 0.7 mm in A; 0.07 mm in B; 0.15 mm in C; 0.075 mm in D; 0.05 mm in E; 0.1 mm in F; 0.08 mm in G; 0.06 mm in H.

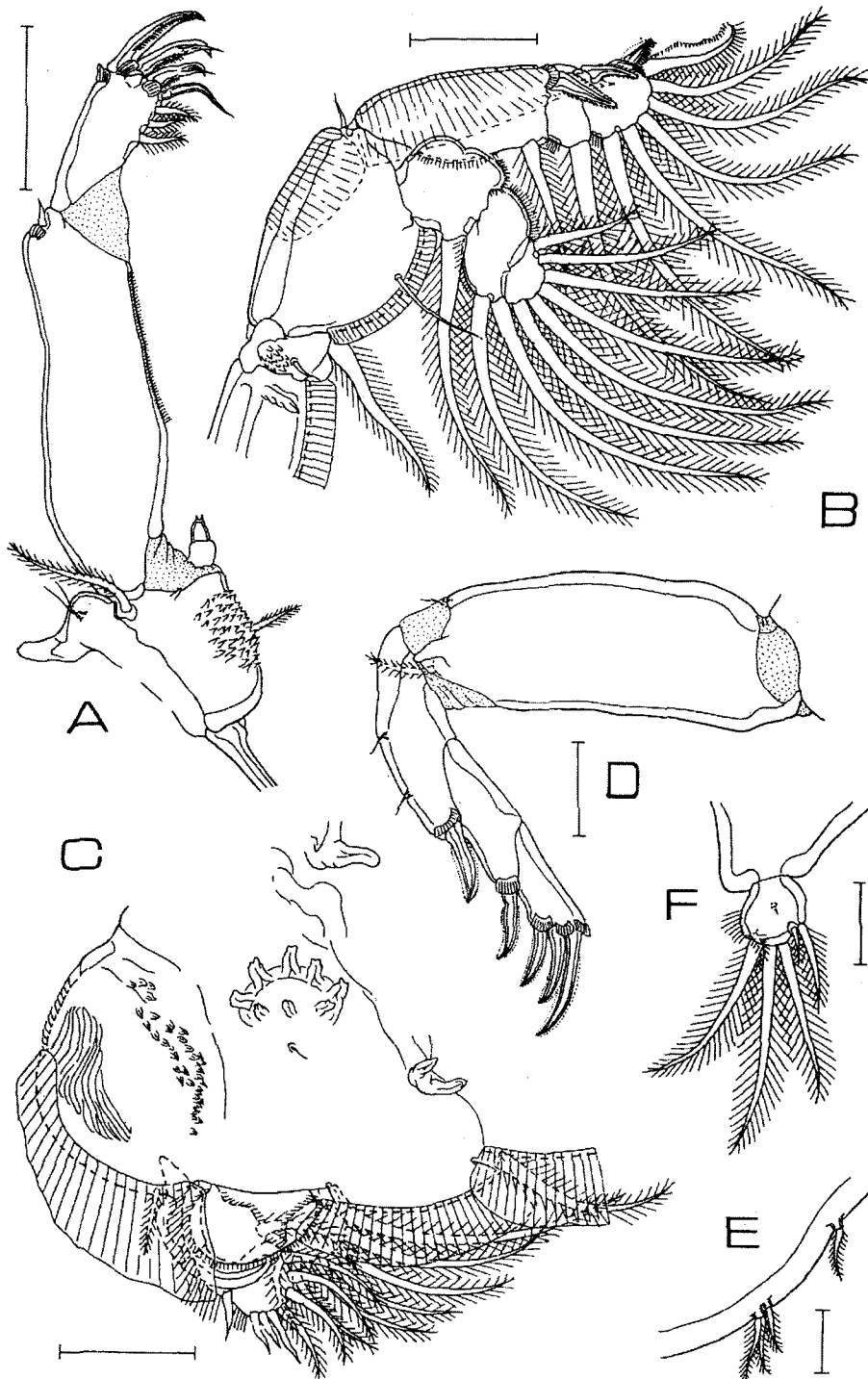


Fig. 4. *Caligus equulae* n. sp., female. A: leg 1, ventral; B: leg 2, ventral; C: leg 3, ventral; D: leg 4, ventral; E: posterolateral margin of genital complex showing leg 5, ventral; F: caudal ramus, ventral. Scale bars: 0.1 mm in A, B, C; 0.07 mm in D, F; 0.05 mm in E.



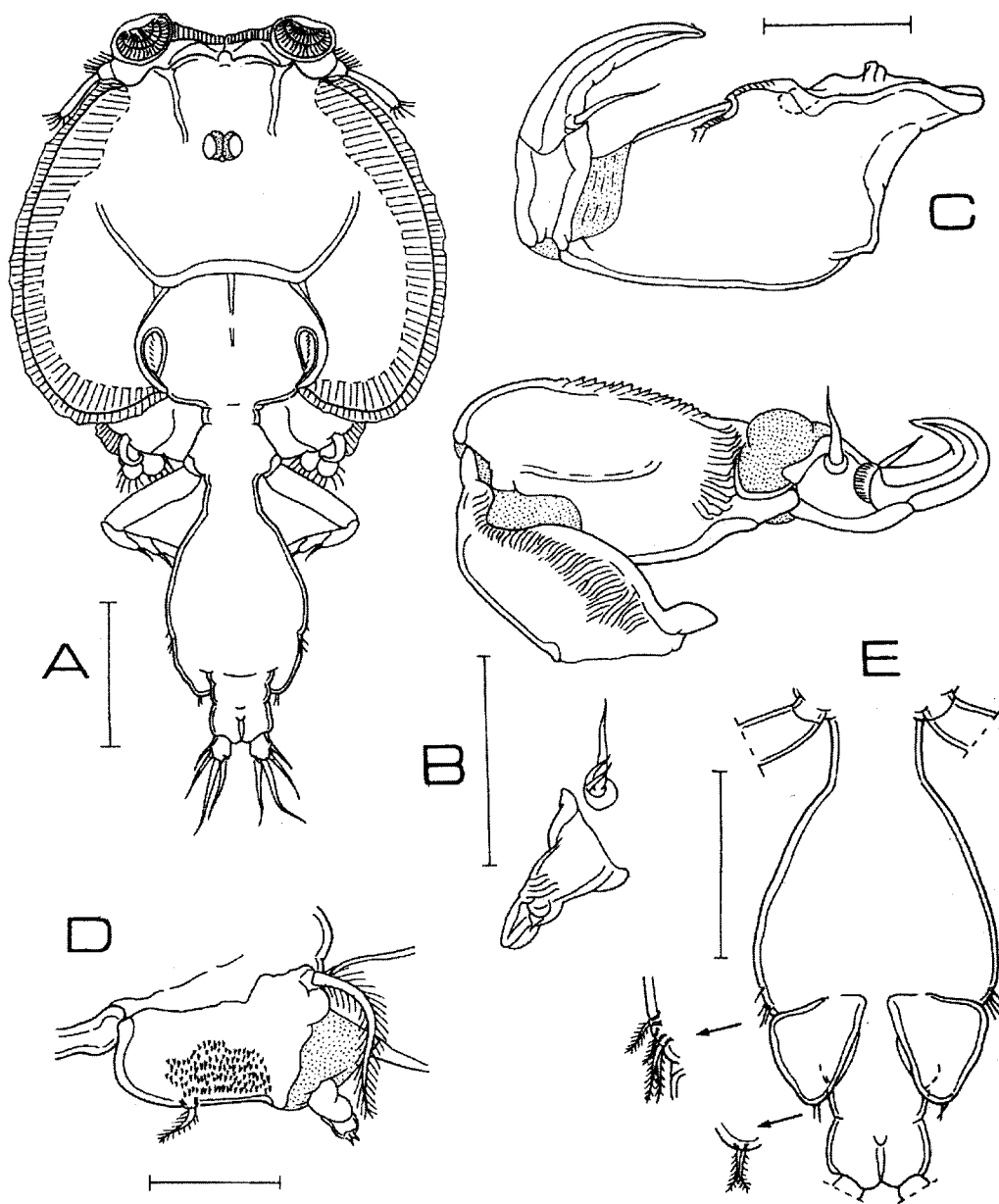
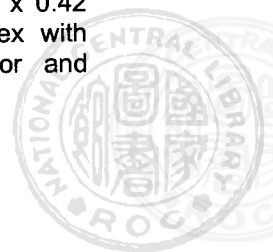


Fig. 5. *Caligus equulae* n. sp., male. A: habitus, dorsal; B: antenna and maxillule, ventral; C: maxilliped; D: basal part of leg 1, ventral; E: genital complex and abdomen, ventral. Scale bars: 0.4 mm in A; 0.1 mm in B, C; 0.05 mm in D; 0.3 mm in E.

sonian Institution in Washington, D. C.

Female: Body (Fig. 3A) 2.74 (2.46-2.94) mm long, excluding setae on caudal rami. Cephalothoracic shield slightly wider than long, 1.12 (0.90-1.26) x 1.27

(1.08-1.52) mm, excluding marginal membranes. Fourth pediger 2.47 times wider than long, 0.17 (0.16-0.20) x 0.42 (0.36-0.54) mm. Genital complex with neck-like narrow part in anterior and



protruded posterolateral portion, 1.24 (1.08-1.38) mm long and 0.97 (0.80-1.14) mm wide. Abdomen small and distinctly wider than long, 99 (81-113) x 172 (162-194) μ m. Caudal ramus (Fig. 4F) small, about 1.3 times longer than wide, 68 (57-73) x 53 (49-57) μ m, and armed with 3 small and 3 large plumose setae in addition to a papilla tipped with a seta on dorsal surface and a row of setules on subterminal portion of medial margin. Egg sac longer than body, 3.70 mm, and containing 44 eggs.

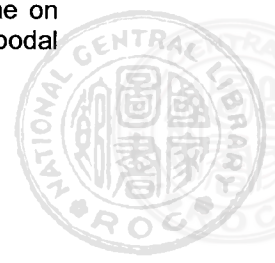
Antennule (Fig. 3B) 2-segmented; proximal segment slightly longer than distal segment and armed with 27 plumose setae on anterodistal surface; distal segment armed with 1 subterminal seta on posterior margin and 11 setae plus 2 aesthetascs on distal margin. Antenna (Fig. 3C) 3-segmented; proximal segment small, with posteromedial plate; middle segment unarmed; distal segment a curved claw with robust seta on a papilla in basal region and another slender one in middle region. Basal part of postantennal process (Fig. 3D) with 2 setules-bearing papillae and 2 tooth-like outgrowths opposite to each other; another similar setules-bearing papilla near by on sternum; process heavily sclerotized and fringed with membrane. Mandible (Fig. 3E) 4-segmented; with 12 teeth on medial margin of distal blade. Maxillule (Fig. 3C) comprising short, bifid dentiform process and papilla bearing 3 setae; a small tooth-like process on sternum located between dentiform process and setae-bearing papilla. Maxilla (Fig. 3F) 2-segmented; proximal segment (lacertus) unarmed; slender distal segment (brachium) carrying large subterminal hyaline membrane on outer edge and 2 unequal elements (short canna and long calamus) terminally. Corpus of maxilliped (Fig. 3G) large, with 3 large, heavily sclerotized, tooth-like processes in myxal region in addition to 2 irregular, small protrusion on medial surface; subchela sharply pointed, with short sheath and longer claw; setiform barbel present. Sternal furca

(Fig. 3H) with subrectangular box; tines divergent, bluntly pointed, and fringed with hyaline membrane.

Armature of rami of legs 1-4 (Figs. 4A-D) as follows (Roman numerals indicating spines and Arabic numerals, setae):

	Exopod	Endopod
Leg 1	1-0; III,1,3	(vestigial)
Leg 2	I-1; I-1; II,1,5	0-1; 0-2; 6
Leg 3	I-0; I-1; III,4	0-1; 6
Leg 4	I-0; I-0; III	(missing)

Leg 1 (Fig. 4A) coxa with setules-bearing papilla close to outer margin; basis with long, outer and short, inner plumose setae in addition to a patch of coarse denticles on ventral surface; vestigial endopod indistinctly 2-segmented and tipped with 2 small elements; first segment of exopod with row of fine spines on posterior edge and small membrane at base of short, spiniform outer seta; middle 2 of 4 terminal elements on last segment of exopod with accessory process; 3 plumose setae on posterior margin of this segment distinctly shorter than element 4 of terminal elements. Leg 2 (Fig. 4B) coxa small, with denticulate knob on ventral surface in addition to usual spinule-bearing papillae and large, plumose inner seta; basis with small, naked outer seta and a long medial setule; both outer and medial edges of protopod fringed with large marginal membrane; first endopodal segment with marginal indentation about midway and fringed with spinules beyond this dent. Leg 3 (Fig. 4C) protopod (apron) armed with large marginal membrane on outer and posterior edges in addition to various forms of ornamentations on ventral surface. Ornamentations including striated area, rows of denticles, wreath of sclerotized knobs, a simple, blunt projection, a bifid outgrowth, and a setule-bearing papilla; outer edge anterior to membrane corrugated. Leg 4 (Fig. 4D) protopod with small, plumose outer seta; proximal segment of exopod with 2 setule-bearing papillae on outer margin; pectens on exopodal



segments at insertion of each of 5 spines. Leg 5 (Fig. 4E) represented by 3 seta-bearing papillae located on posterolateral margin of genital complex.

Male: Body (Fig. 5A) 1.86 (1.72-1.96) mm long, excluding setae on caudal rami. Cephalothoracic shield slightly wider than long, 0.98 (0.88-1.02) x 1.05 (0.94-1.12) mm. Fourth pediger with narrowed anterior portion and 1.88 times wider than long, 131 (89-146) x 246 (219-159) μ m. Genital complex oblong, 578 (494-689) x 373 (316-462) μ m, with narrowed anterior portion, wider posterior portion carrying a pair of large, posteroventral lobes. Abdomen indistinctly 2-segmented; anterior segment 78 (73-89) x 165 (154-178) μ m, posterior segment 103 (89-113) x 157 (138-170) μ m. Caudal ramus armed as in female, 62 (57-65) x 54 (49-57) μ m.

Antenna (Fig. 5B) 3-segmented; proximal segment small, with large corrugated pad on medial surface; middle segment largest, with corrugated medial and ventral surfaces; distal segment a large claw with two setae in basal region. Dentiform process of maxillule (Fig. 5B) different from that of female in having robust, accessory seta, fringed with membrane on distal outer margin, and lacking sternal process. Corpus of maxilliped (Fig. 5C) robust, bearing on medial surface a sclerotized, flat-top protrusions. Patch of small spinules on ventral surface of basis of leg 1 (Fig. 5D). Leg 5 (Fig. 5E) represented by 3 closely arranged, seta-bearing papillae on posterolateral margin of genital complex; anterior 2 papillae tipped with single, pinnate seta, but posterior one, 2 pinnate setae. Leg 6 (Fig. 5E) represented by a large lobe on posteroventral side of genital complex tipped with 2 small, plumose setae.

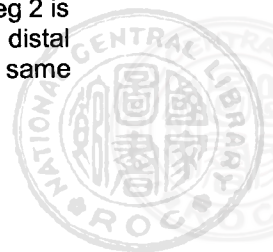
Etymology: The specific name of the parasite, *equulae*, was taken from the specific name of its host *Carangoides equula*.

Remarks: This is the first recording of *Caligus* from the whitefin trevally, *Carangoides equula*. Previously, only

one species of pennellid copepods, *Lernaenicus kabatai* Oldewage, has been recorded from this species of fish in South Africa (Oldewage, 1989).

The present new species is characteristic in having an extremely small abdomen, which is only about one-tenths the length of the genital complex to which it attaches. Such a tiny abdomen is found in only two (out of more than 250) species of its congeners, namely, *C. afurcatus* Wilson, 1913 and *C. enormis* Wilson, 1913. Both of them are so far known only from the fishes of the West Indies (Wilson, 1913). Based on Cressey's redescription of *C. afurcatus*, the new species can be easily distinguished from it by the possession of (1) an anterior and another posterior projections on the base of the postantennal process (Fig. 3D), (2) an accessory process on the dentiform process of the maxillule (Fig. 3C), and (3) a sharp, tooth-like process by the base of the maxillule (Fig. 3C). Besides, some more differences are also exhibited in the structure of the outer spines on the exopods of legs 2 and 3. These spines are generally thinner, longer, and lightly armed in *C. afurcatus*.

Unlike *C. afurcatus*, the other resembling species from the West Indies, *C. enormis*, has not been redescribed since Wilson's (1913) original work. Since Wilson's original description is short of the details of the appendages, it is impossible to make a close comparison between it and the present new species. However, according to Ho and Bashirullah's (1977) published information on their reexamination of the type-specimens of *C. enormis* (kept in the National Museum of Natural History in Washington, D.C.), the new species can be distinguished from it by the difference in the armature on the exopod of leg 1. In *C. enormis* there is no plumose setae on the posterior margin of the terminal segment of the exopod of leg 1. Besides, the outer spine on the proximal segment of the exopod of leg 2 is unusually long, reaching out to the distal rim of the terminal segment of the same



ramus.

In comparing with the *Caligus* of Taiwan, it was found that the new species is closest to *C. confusus* Pillai and *C. cordyla* Pillai in having a relatively small abdomen, an antennule with long distal segment, and bearing an accessory process on the dentiform process of maxillule. The interesting point here is both *C. confusus* and *C. cordyla* are also parasitic on the carangid fish just like *C. equulae* (Ho and Lin, 2001). However, *C. equulae* is distinguishable from these two resembling species in Taiwan by the possession of 3 protuberances in the myxal region of the corpus of the maxilliped and 3 small and short (instead of large and long) plumose setae on the posterior margin of the terminal segment of the exopod of leg 1.

Caligus patulus Wilson, 1937
(Figs. 6, 7)

Material examined: 5 ♀♀ in basal groove of dorsal fin of 4 (out of 12 examined) milkfishes, *Chanos chanos* (Forsskål), landed at Da-Hsi Fishing Port in I-Lan County on July 17, 2002.

Female: Body (Fig. 6A) 4.61 (4.46-4.78) mm long, excluding setae on caudal rami. Cephalothoracic shield slightly longer than wide, 2.89 (2.84-3.00) x 2.35 (2.32-2.40) mm, excluding marginal membranes. Fourth pediger 5.18 times wider than long, 0.17 (0.16-0.20) x 0.88 (0.82-0.92) mm. Genital complex subquadrate, 1.26 (1.20-1.32) x 1.69 (1.58-1.78) mm, with posteriorly protruded posterolateral corners. Abdomen 1-segmented, with narrowed anterior portion, slightly longer than wide, 0.36 (0.34-0.40) x 0.32 (0.30-0.40) mm. Caudal ramus (Fig. 7F) longer than wide, 0.11 (0.10-0.12) x 0.07 (0.06-0.08) mm, carrying distally 3 short and 3 long plumose seta in addition to a setule bearing papilla on dorsal surface and a row of spinules on terminal portion of medial margin.. Egg sac shorter than body, 2.82 mm long, containing 27 eggs.

Antennule (Fig. 6B) 2-segmented, proximal segment distinctly longer than

distal segment, with 27 plumose setae on anterodistal surface; distal segment armed with 1 subterminal seta on posterior margin and 11 setae plus 2 aesthetascs on distal margin. Antenna (Fig. 6C) 3-segmented; proximal segment with robust, bluntly pointed posteromedial process; middle segment unarmed; distal segment a curved, sharp claw bearing 2 setae, one in basal region and another one close to outer margin. Postantennary process (Fig. 6C) bluntly pointed; 2 papillae in basal region with each bearing 4 setules, another similar papilla on sternum. Mandible (Fig. 6D) 4-segmented, with 12 teeth on medial margin of distal blade. Maxillule (Fig. 6C) comprising short, bluntly pointed, dentiform process and basal papilla bearing 3 setae. Maxilla (Fig. 6E) 2-segmented; proximal segment (lacertus) unarmed; distal segment (brachium) slender, carrying subterminally hyaline membrane on outer edge and terminally a short, bluntly pointed canna and a long calamus. Corpus of maxilliped (Fig. 6F) long but unarmed; shaft shorter than terminal claw and unarmed; terminal claw with tiny basal spine. Box of sternal furca (Fig. 6G) subrectangular; tines broad and parallel.

Armature of rami of legs 1-4 (Figs. 7A-D) as follows (Roman numerals indicating spines and Arabic numerals, setae):

	Exopod	Endopod
Leg 1	1-0; III,1,3	(vestigial)
Leg 2	I-1; I-1; II,1,5	0-1; 0-2; 6
Leg 3	I-0; IV,5	0-1; 6
Leg 4	I-0; III	(missing)

Coxa of leg 1 (Fig. 7A) with setule-bearing papilla on outer region; basis with outer and inner plumose setae. Vestigial endopod tipped with tiny element; first segment of exopod with row of long spinules on posterior edge and short spiniform seta at outer distal corner; outer 3 of 4 terminal elements denticulate on outer margin and cover by a pecten in



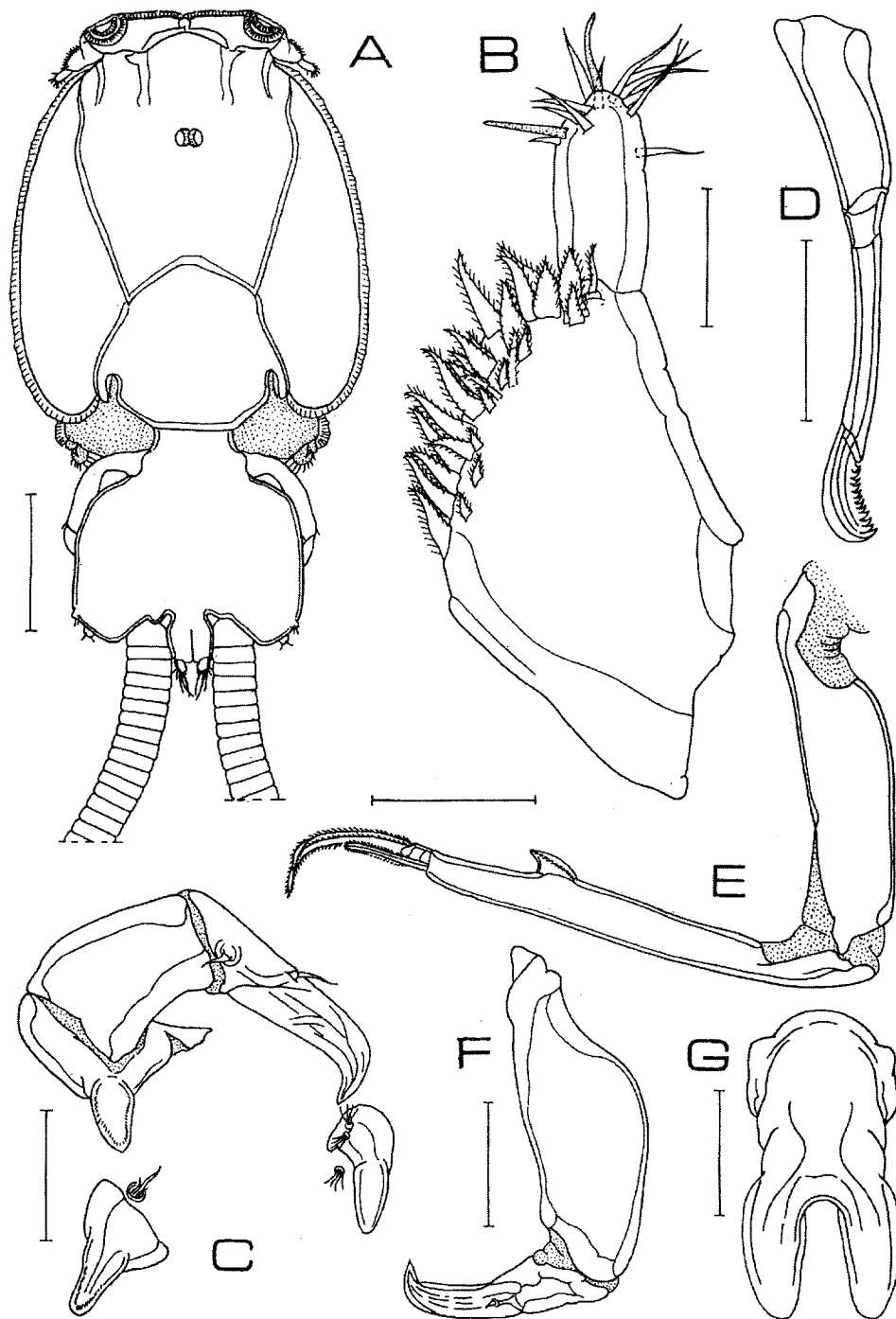


Fig. 6. *Caligus patulus* Wilson, female. A: habitus, dorsal; B: antennule, ventral; C: antenna, postantennal process, and maxillule, ventral; D: mandible; E: maxilla; F: maxilliped; G: sternal furca, ventral. Scale bars: 1mm in A; 0.08 mm in B, D; 0.2 mm in C; 0.25 mm in E; 0.3 mm in F; 0.15 mm in G.

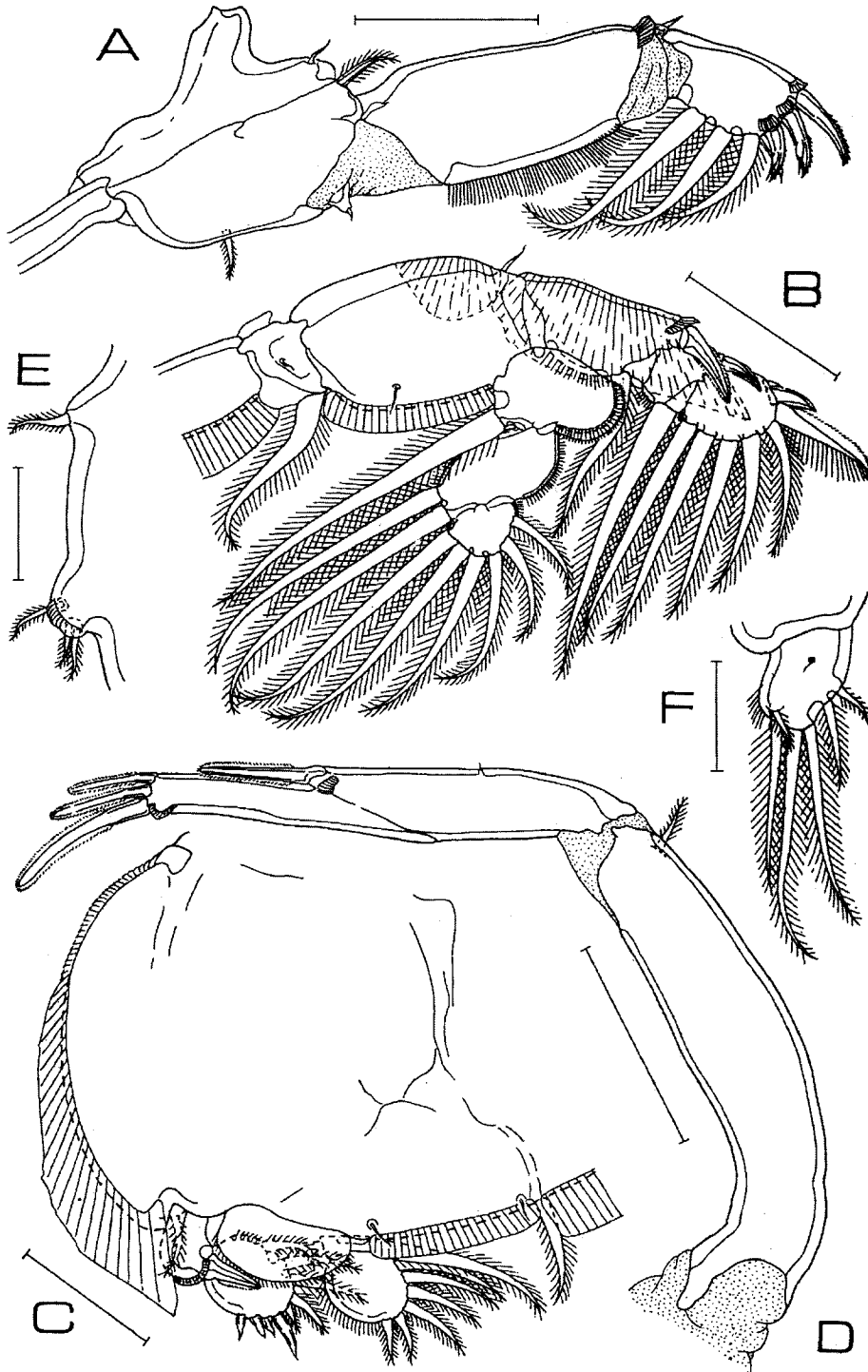


Fig. 7. *Caligus patulus* Wilson, female. A: leg 1, ventral; B: leg 2, ventral; C: leg 3, ventral; D: leg 4, ventral; E: posterolateral margin of genital complex showing leg 5, ventral; F: caudal ramus, dorsal. Scale bars: 0.2 mm in A, C; 0.3 mm in B, D; 0.1 mm in E, F.



basal region; 2 middle elements with accessory process. Leg 2 (Fig. 7B) coxa small, with spinule on ventral surface and large, plumose seta on posterior edge; basis with small, naked outer seta and papilla tipped with setule near posterior margin; both outer and medial edges of protopod fringed with large marginal membrane; lateral portion of proximal segment of endopod enlarged outward and making it 1.52 times wider than long. Leg 3 (Fig. 7C) protopod (apron) with large marginal membrane on outer and posterior edges in addition to 2 setule-bearing papillae on ventral surface with each close to one end of posterior hyaline membrane; lateral margin anterior to outer membrane corrugated. Leg 4 (Fig. 7D) protopod with small, plumose outer seta; pectens on exopodal segments at insertion of proximal and distoinner spines; outer margin of proximal segment of exopod with setule-bearing papilla. Leg 5 (Fig. 7E) represented by 2 small, protrusions on posterolateral corner of genital complex, with anterior one bearing 1 small, plumose seta and posterior one, 3 small, plumose setae.

Male: Not collected [but dealt with in Jones' (1980) redescription].

Remarks: So far five species of caligid copepods have been reported from milkfish. They are, in addition to *C. patulus*, *Caritus serratus* Cressey, 1967 from Malagasca (Cressey, 1967) and India (Prabha and Pillai, 1983); *Caligus epidemicus* Hewitt, 1971 from Philippines (Regidor and Arthur, 1986); *Caligus punctatus* Shiino, 1955 from Taiwan (Lin, 1989); and *Caligus orientalis* Gusev, 1955 also from Taiwan (Lin and Ho, 1998). *C. patulus* is easily distinguished from these four species of host-sharing caligids by the possession of an unusual characteristic for the sea lice – with 2-segmented exopod on leg 3.

C. patulus was first recovered from a milkfish caught in Panama Bay, Panama (Wilson, 1937). The host was then called "*Chanos sp.*" Since there is but one species of milkfish in the world

(Froese and Pauly, 2002), Wilson's incompletely named host must be *Chanos chanos*. Wilson's (1937) original description of *C. patulus* is scanty, with errors, and lacking information of the fine structures on almost all appendages. Fortunately, Jones (1980) restudied Wilson's (1937) holotype female of *C. patulus* to correct errors in the original description when he was studying the specimens of *C. patulus* obtained from the milkfish cultured in Philippines. Identification of the specimens from Taiwan was based chiefly on Jones' (1980) redescription.

It is interesting to point out that *C. patulus* is not host specific to milkfish. Burnett-Herkes (1974) has found it on the common dolphinfish, *Coryphaena hippurus* Linnaeus, occurring in the Straits of Florida. Thus, it prompted Jones (1980) to speculate that the widespread distribution of *C. patulus* may be explained by the fact that the parasite can occur (survive successfully) on the oceanic fish like common dolphinfish and thus provides a chance of trans-oceanic distribution.

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三種寄生於台灣東北海岸的海水魚體上之魚虱 (橈足類亞綱：魚虱科)

何汝諧¹·林清龍^{2*}

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本篇描述三種採自宜蘭大溪漁港的三種海水魚體上的魚虱(橈足類亞綱：魚虱科)。它們分別是寄生於眼眶魚[*Mene maculate* (Bloch & Schneider)]上的 *Caligus amblygenitalis* Pillai, 1961;寄生於高體若鰺[*Carangoides equula* (Temminck & Schlegel)]上的 *C. equulae* n. sp.,和寄生於虱目魚[*Chanos chanos* (Forsskål)]上的 *C. patulus* Wilson, 1937. *Caligus amblygenitalis* 是首次在印度以外之區域被發現。新種 *C. equulae* 與 *C. confuses* Pillai, 1961 及 *C. cordyla* Pillai, 1963 最相似，與它們明顯不同之處在於：1. *C. equulae* 的顎足(maxilliped)的體部(corpus)其內緣有三個突起；2.第一胸腳的外肢其末節後緣上的三支羽狀剛毛小而短(而非大而長)。第三種的 *C. patulus* 是台灣的新發現種。

關鍵詞：魚虱科，魚虱屬，寄生橈足類，海水魚，台灣。

¹加州州立大學長灘分校生物科學系，加州，90840-3702，美國

²國立嘉義大學水產生物系

* 通訊作者

