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A redescription of *Lepeophtheirus ericsoni* Thomson, 1891 and some comparisons with *L. scutiger* Shiino, 1952 and a new species, *L. sheni* (Crustacea: Copepoda)

G. A. Boxshall* and D. R. Bellwood**

Lepeophtheirus ericsoni, a parasitic copepod from New Zealand waters, is redescribed. Specimens of *L. scutiger* recorded from New Zealand fishes are here reidentified as *L. ericsoni*, and the host list of this parasite now includes *Latridopsis ciliaris*, *Pseudolabrus miles*, *P. celidotus*, *P. pittensis*, *P. cinctus* and *Coridodax pullus*, of which the last two are new. *L. scutiger* is redescribed from the type material, and a new species, *L. sheni*, closely related to *L. scutiger*, is described. *L. scutiger* is only known to occur on *Hexagrammos otakii* from Japanese waters. *L. sheni* is known to parasitize *H. otakii* both from Japanese waters and the North China Sea and *Platichthys bicoloratus* from the Yalukiang Estuary, China.

INTRODUCTION

Lepeophtheirus ericsoni was first described by Thomson (1891) from specimens taken from *Latridopsis ciliaris* (Bloch & Schneider) caught off New Zealand. Most subsequent references to this species, Bassett-Smith (1899, as *L. erichsoni*), Wilson (1905), Yamaguti (1963) and Dojiri (1979) refer only to the original description. Hewitt (1963) reported 1 adult male and 3 juveniles of *L. ericsoni* from the same host fish, and Rohde *et al.* (1980) found a single specimen, also on *Latridopsis ciliaris*, but because of the paucity of material and its state of preservation these authors were unable to redescribe *L. ericsoni*. Examination of some copepods from New Zealand, provisionally identified as *L. scutiger* Shiino, 1952, revealed a high degree of similarity to *L. ericsoni* as described by Thomson (1891). A detailed comparison of *L. ericsoni* and *L. scutiger* was therefore undertaken in order to establish valid morphological criteria for distinguishing between them. During the course of this comparison a new species, *L. sheni*, was discovered which is closely related to *L. scutiger* and which has been confused with it by both Shiino (1952) and Shen (1958).

METHODS

Specimens were dissected and examined in lactophenol using phase-contrast microscopy, and all drawings were made using a camera lucida. The terminology adopted is based on that of Kabata (1979).

DESCRIPTIONS

Lepeophtheirus ericsoni Thomson, 1891 (Figs. 1-3)

Lepeophtheirus ericsoni Thomson 1891: 227-229, pl. XXIII.

Lepeophtheirus erichsoni: Bassett-Smith 1899: 455.

Lepeophtheirus scutiger: Hewitt 1963: 84-91, Text figs. 7-8.

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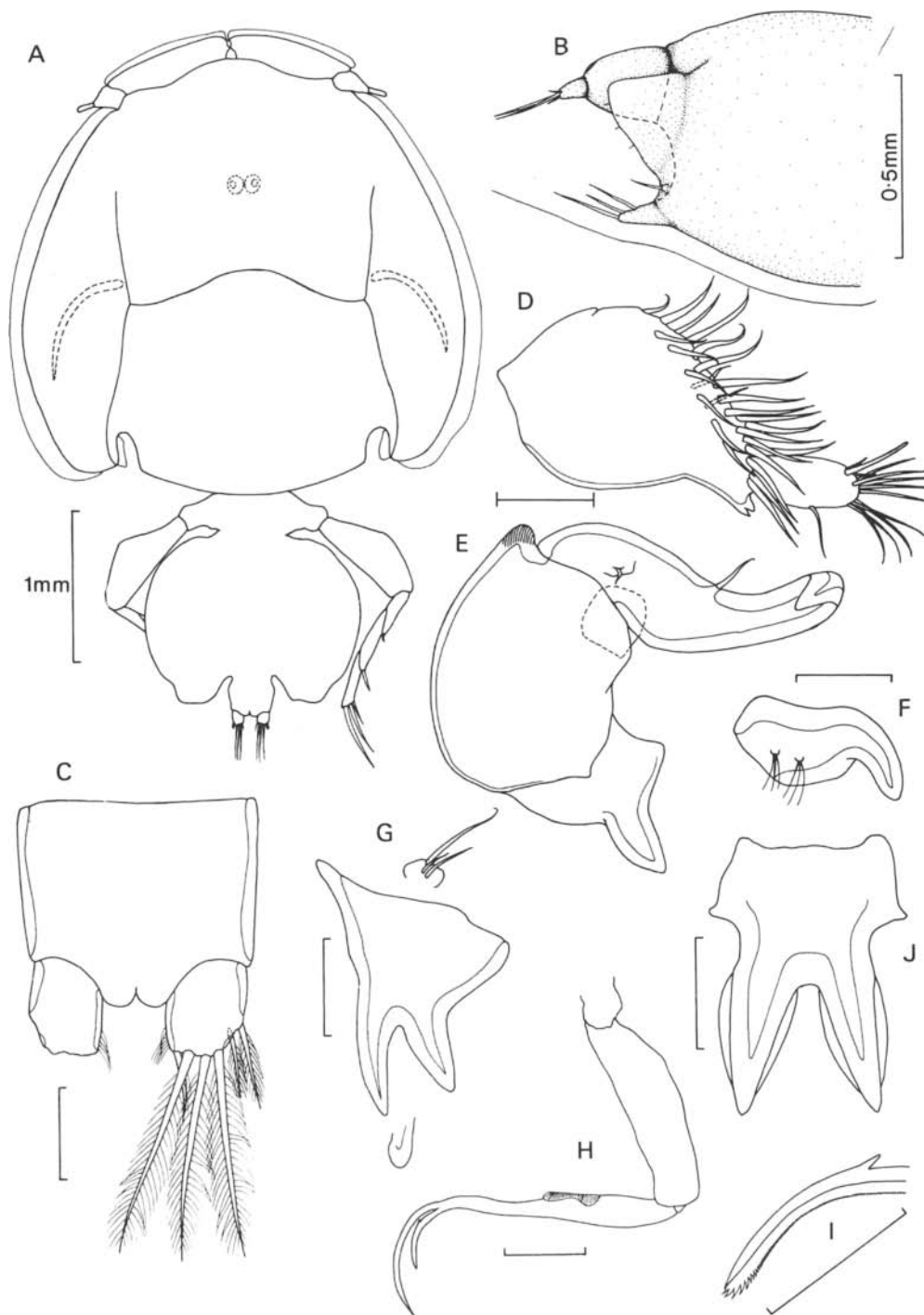


Fig. 1 — *Lepeophtheirus ericsoni* female. A, syntype, dorsal (with third legs omitted for clarity); B, abdomen and posterior extremity of genital complex, lateral; C, abdomen, ventral; D, female first antenna, ventral; E, second antenna, ventral; F, postantennary process, ventral; G, first maxilla, ventral; H, second maxilla, ventral; I, canna of second maxilla, ventral; J, sternal furca, anteroventral. Scale 100 μ m unless otherwise stated.

Adult female. Dorsal shield (Fig. 1A) subcircular, possessing broad, shallow posterior sinuses. Free margin of thoracic zone of dorsal shield extending beyond posterior tips of lateral zones. Lateral zones each with simple cuticular rib on ventral surface. Genital

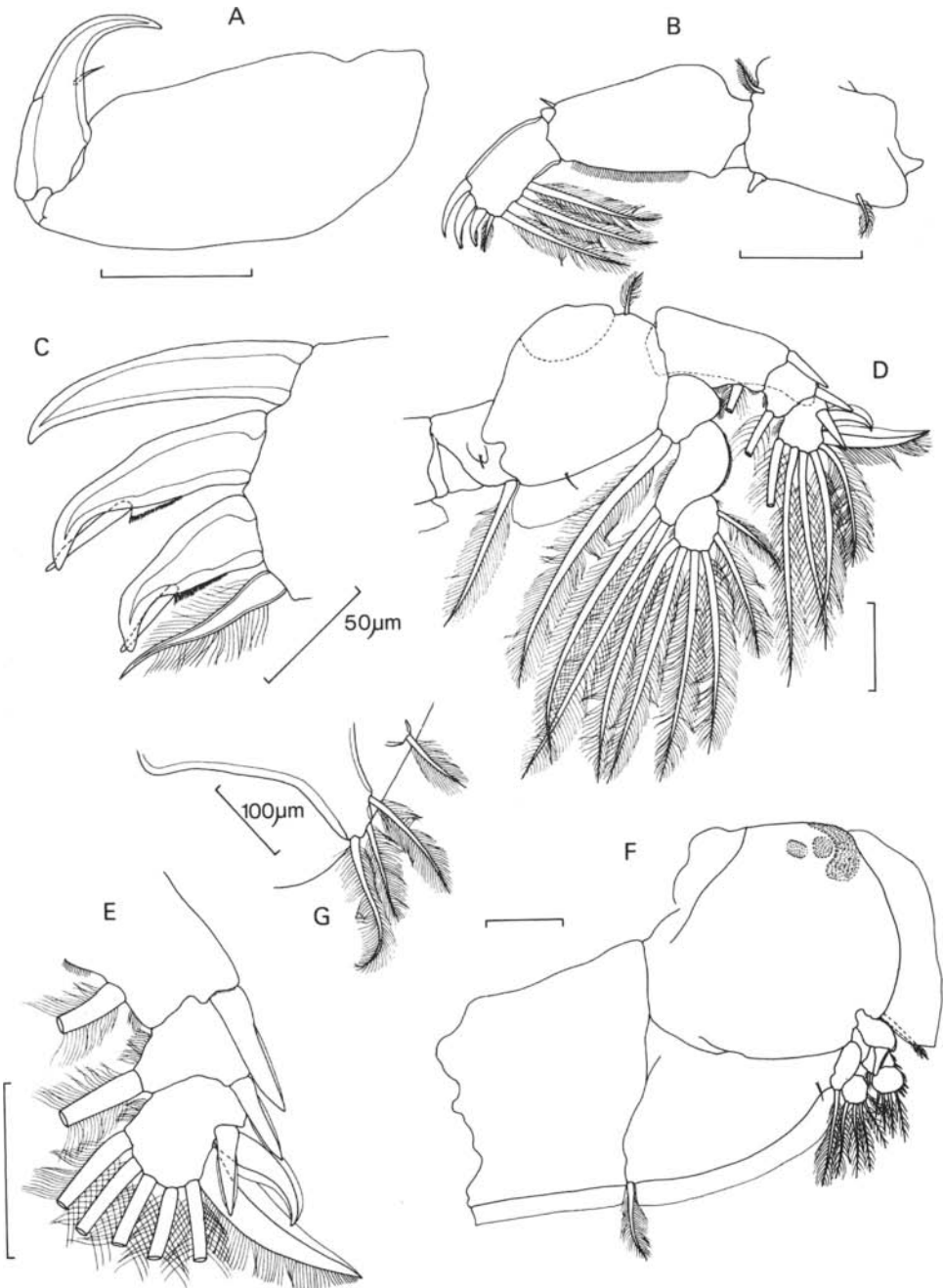


Fig. 2 — *Lepeophtheirus eresonii* female. A, maxilliped, posterior; B, first leg, ventral; C, tip of first leg exopod, ventral; D, second leg, ventral; E, exopod of second leg, ventral; F, third leg, ventral; G, fifth leg, ventral. Scale 200 µm unless otherwise stated.

complex wider than long, with rounded lateral margins and well-developed posterolateral lobes extending almost to end of abdomen (Fig. 1B). Abdomen (Fig. 1C) 1-segmented, wider than long. Caudal rami longer than wide, each with distally plumose medial margin and bearing 3 long plumose setae on distal margin and 3 small plumose setae, 1 at posteromedial angle, 1 subapically on lateral margin and 1 on dorsal surface near base of lateral seta.

First antenna (Fig. 1D) 2-segmented; robust basal segment bearing 24 setae on anterior margin and 2 dorsally, posterior margin distinctly notched about midlength and with a variable bifid process distally; second segment about twice as long as wide and bearing 13 armature elements. Second antenna (Fig. 1E) 3-segmented; basal segment with a posteriorly-directed tine-like process, middle segment robust with a large dorsal process covered with surface ridges situated near distal margin and also with fine surface striations at apex of segment; terminal segment subdivided into basal portion carrying a ventral seta proximally and a distal margin seta, and apical portion forming a strongly recurved claw. Postantennal process (Fig. 1F) a broad base and short tine. First maxilla (Fig. 1G) comprising anterior nodule bearing 3 unequal naked setae and bifid posterior process; tines subequal in length, moderately divergent but lateral tine broader than medial. Second maxilla (Fig. 1H) 3-segmented; terminal segment narrowing markedly at midlength and bearing bilobed strips of membrane; calamus armed with narrow strips of fine membrane, canna with conspicuous barb (Fig. 1I) on convex margin and serrated membrane along concave margin. Maxilliped (Fig. 2A) basal segment robust, terminal segment a curved claw bearing a slender naked seta at the incomplete suture line. Sternal furca (Fig. 1J) tines broad, divergent and with bilateral marginal flanges; box broad, subrectangular with produced angles.

First leg (Fig. 2B) sympod with 1 plumose seta near posterior margin and 1 near base of exopod. Vestigial endopod with minute apical spinules. Exopod segment 2 with 3 long plumose setae on posterior margin and 4 distal margin elements (Fig. 2C): spine 1 simple, spines 2 and 3 each with a secondary process distally and a strip of serrated marginal membrane, seta 4 plumose and just longer than spine 3. Second leg (Fig. 2D) sympod segment 1 with a plumose seta on posterior margin and a short setule on a swelling on the ventral surface; segment 2 with dorsal membrane and 1 plumose seta anteriorly and 1 setule and marginal membrane posteriorly. Endopod 3-segmented, segments 1 and 2 with 1 and 2 medial margin plumose setae respectively, segment 3 with 6 marginal setae, all free margins bearing pinnules. Exopod 3-segmented (Fig. 2E); segment 1 with medial plumose seta, lateral membrane (reflexed over dorsal surface) and outer distal spine, segment 2 with medial seta and outer distal spine, segment 3 with 5 distal margin plumose setae, an apical seta with plumose medial margin and membrane along lateral margin, and 2 lateral spines both with strips of marginal membrane. Third leg (Fig. 2F) plate-like and fused to expanded interpodal bar; sympod subdivided into anterolateral and posteromedial portions by cuticular surface ridges; anterolateral portion with areas of ridged cuticle dorsally, a broad marginal membrane laterally and 1 plumose seta near base of exopod; posteromedial portion with marginal membrane and a medial plumose seta. Endopod (Fig. 3A) 2-segmented; segment 1 with a medial plumose seta and expanded lateral margin bearing pinnules, segment 2 with 6 plumose setae. Exopod (Fig. 3A) 3-segmented; segment 1 with marginal membrane and 3 setules laterally and a robust subapical spine on distal margin; segment 2 with medial plumose seta and lateral spine; segment 3 with 4 plumose setae medially and 3 short spines laterally.

Fourth leg (Fig. 3B) 4-segmented, long, extending beyond posterior margin of genital complex; stout basal segment extending well beyond 'shoulders' of genital complex when viewed dorsally (Fig. 1A), segment 2 with small spine at apex, segment 3 with longer bilaterally serrate spine at apex, segment 4 with 3 distal margin setae decreasing in size laterally; innermost seta with lateral serrate membrane, middle and outermost (Fig. 3C) setae with bilateral serrate membranes. Outer margins of segments 2-4 each with a strip of serrated membrane. Fifth leg (Fig. 2G) a conical process bearing 1 apical and 2 lateral plumose setae, and a small papilla on the body surface bearing an apical seta.

Body length of adult female ranging from 4.08 to 4.72 mm, with a mean of 4.4 mm, based on measurements of 45 specimens.

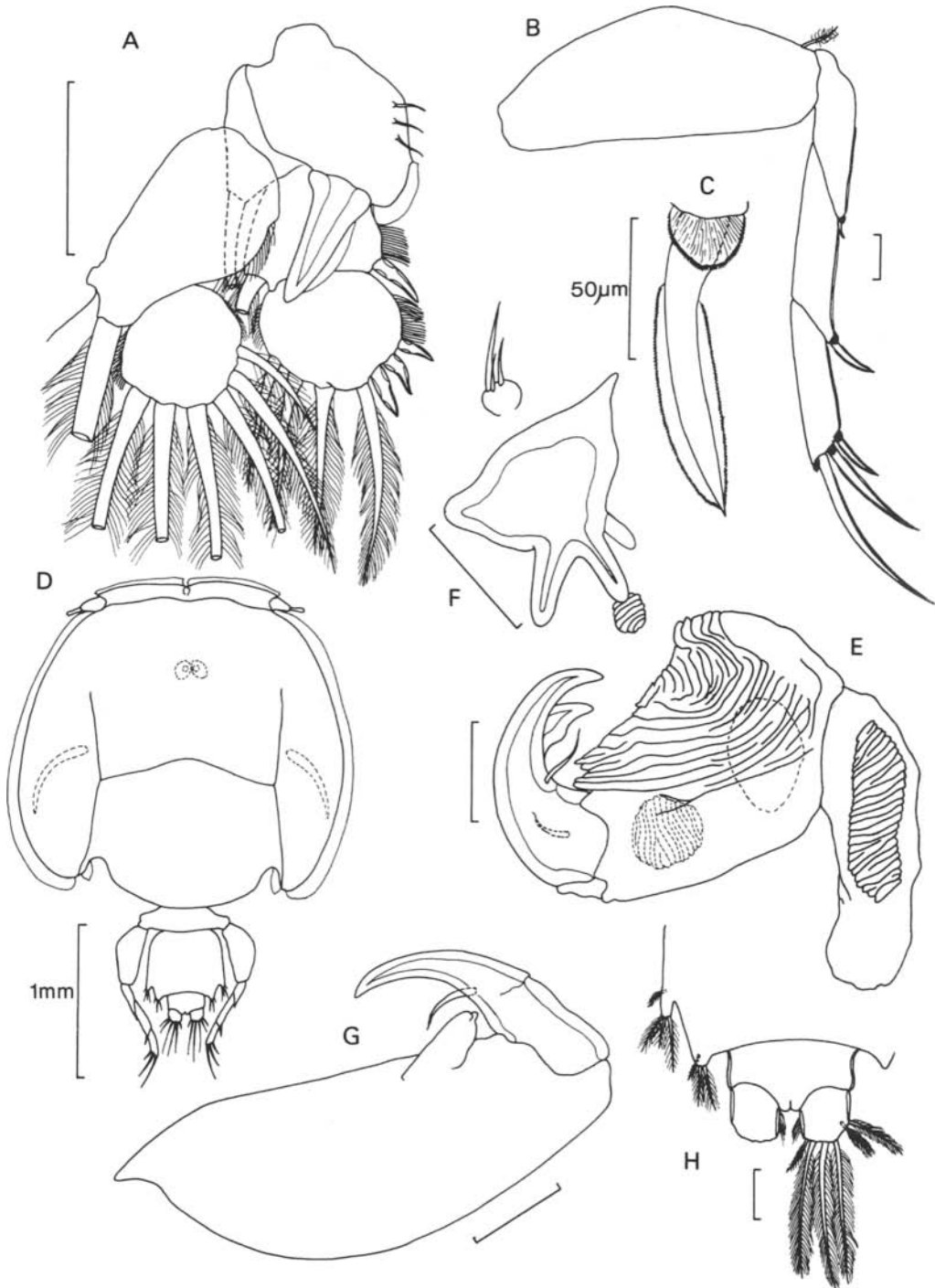


Fig. 3 — *Lepeophtheirus erexsoni* female and male. A, female third leg rami, ventral; B, fourth leg, ventral; C, outer distal seta of fourth leg, ventral; D, male, dorsal (with third legs omitted for clarity); E, second antenna, posteroventral; F, first maxilla, ventral; G, maxilliped, posterior; H, abdomen and fifth leg, ventral. Scale $100\ \mu\text{m}$ unless otherwise stated.

Adult male. Dorsal shield (Fig. 3D) broader and rounder than female. Genital complex slightly wider than long and approximately half as long as thoracic zone of dorsal shield. Abdomen (Fig. 3H) about 1.8 times wider than long. Caudal rami about as long as wide and armed as in female.

Appendages as in female except second antenna, first maxilla, maxilliped and fifth and sixth legs. Second antenna (Fig. 3E) 3-segmented; segment 1 slender with elongate corrugated adhesion pad ventrally, segment 2 with an expanded anterior surface bearing an extensive corrugated adhesion pad anteroventrally, and 2 oval adhesion pads dorsally, segment 3 forming a bifid claw with 2 naked setae proximally. First maxilla (Fig. 3F) with slimmer tines than in female and an additional process on medial surface. Small adhesion pad on body surface just posterior to first maxilla. Maxilliped (Fig. 3G) relatively larger in relation to body size than in female, bearing a dactyliform process with a bifurcate tip on distal portion of myxal surface. Fifth leg (Fig. 3H) a conical process on lateral margin of genital complex, bearing 1 lateral and 3 terminal plumose setae. Sixth leg (Fig. 3H) represented by a small process armed with 1 lateral and 2 terminal plumose setae.

Body length of adult male ranging from 2.77 to 3.0 mm, with a mean of 2.9 mm, based on measurements of 8 specimens.

Material examined. 29♀♀ (A 80.8-80.37), 6♂♂ (A 80.38-80.43), 5 juveniles (A 80.44-80.48), syntypes of *L. erecsoni*. From body surface of moki (*Latridopsis ciliaris*) caught off New Zealand, in collections of the Otago Museum, Dunedin.

13♀♀, 1♂ from *Latridopsis ciliaris*; 1♀, 1♂, 1 juvenile from *Pseudolabrus cinctus* (Hutton) and 4♀♀, 3♂♂, 2 juveniles from *Coriododax pullus* (Bloch & Schneider). All host fishes collected off S.E. New Zealand by D. H. Graham and maintained in an observation tank before removal of parasites. BM(NH) Reg. Nos 1940.4.24.11-21 and 1940.4.24.60-68.

13♀♀, 9♂♂, 14 juveniles described by Hewitt (1963) as *Lepeophtheirus scutiger*, from *Pseudolabrus miles* (Bloch & Schneider), *P. celidotus* (Forster) and *P. pittensis* Waite caught in Wellington Harbour, New Zealand.

Remarks. The material from the Otago Museum, obtained through the kindness of Dr Gordon Hewitt, is regarded as the syntype material. It was deposited there by G.M.T. (Thomson) in 1910 and the label states 'On body of Moki'. This corresponds to the host and site data given by Thomson (1891).

The most characteristic features of *L. erecsoni* are the broad rounded genital complex in the female with its large posterolateral lobes, the large fourth leg (which is longer than the genital complex and the first segment of which extends beyond the 'shoulders' of the genital complex), and the box of the sternal furca. The structure of the second antenna and the maxilliped in the male are also distinctive. On the basis of these characters the Graham material in the BM(NH) and the specimens described by Hewitt (1963) as *L. scutiger*, and kindly loaned by him, are referred to *L. erecsoni*.

***Lepeophtheirus scutiger* Shiino, 1952 (Fig. 4)**

Lepeophtheirus scutiger Shiino 1952: 108-112, Figs. 13-14.

non *Lepeophtheirus scutiger*: Shen 1958: 139-140, pl. I.

non *Lepeophtheirus scutiger*: Hewitt 1963: 84-91, Text Figs. 7-8.

Shiino's original description (1952) of *L. scutiger* is accurate but lacks sufficient detail to permit close comparison with *L. erecsoni*. The syntype series of *L. scutiger* was obtained from the collections of the University of Mie, through the kindness of Dr K. Izawa, and the following supplement to the original description is based on examination of these types.

Adult female. Dorsal shield (Fig. 4A) subcircular, with deep posterior sinuses. Lateral zones of dorsal shield with simple cuticular ribs on ventral surface. Genital complex wider than long with rounded margins, posterior margins rounded but without posterolateral lobes. Abdomen (Fig. 4B) 1-segmented, wider than long. Caudal rami wider than long and like a parallelogram in outline on the steeply angled posterior margin of the abdomen, armature elements as in *L. erecsoni*.

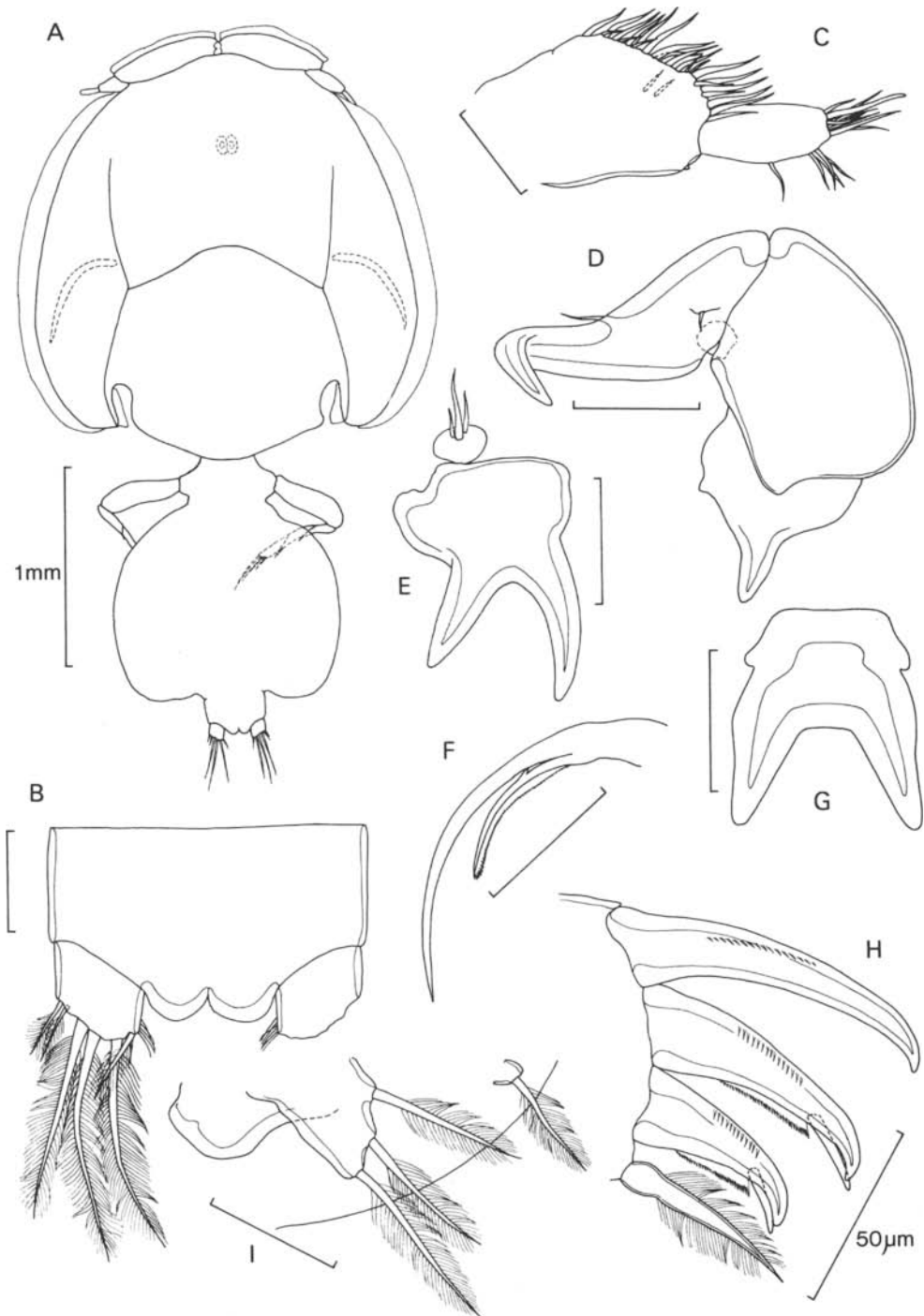


Fig. 4 — *Lepeophtheirus scutiger* paralectotype female. A, dorsal (with third legs omitted for clarity); B, abdomen, ventral; C, first antenna, ventral; D, second antenna, ventral; E, first maxilla, ventral; F, calamus and canna of second maxilla, ventral; G, sternal furca, anteroventral; H, tip of first leg exopod, ventral; I, fifth leg, ventral. Scale 100 μ m unless otherwise stated.

Appendages similar to those of *L. erecsoni* in segmentation and basic armature elements, differences in armature given below. First antenna (Fig. 4C) segment 1 posterior margin slightly concave and bearing single minute process distally. Second antenna (Fig. 4D) terminal segment with small naked seta proximally on ventral surface and slender seta on anterior margin. First maxilla (Fig. 4E) tines of posterior process more divergent than in *L. erecsoni*. Second maxilla (Fig. 4F) canna with conspicuous barb on convex margin and serrated membrane along concave margin. Sternal furca (Fig. 4G) tines divergent, tapering more-or-less regularly and without conspicuous lateral flanges. First leg with similar armature elements on tip of exopod (Fig. 4H) to those of *L. erecsoni*, except spines 1, 2 and 3 each have an additional row of fine spinules on their ventral surfaces near the convex margin. Fourth leg much shorter than genital complex (Fig. 4A) and with first segment not extending beyond 'shoulders' of genital complex. Fifth leg (Fig. 4I) slightly broader than in *L. erecsoni*.

Body length of adult female ranging from 3.23 to 3.57 mm, with a mean of 3.4 mm, based on measurements of four specimens.

Male unknown.

Material examined. Lectotype ♀, 3♀♀ paralectotypes of *L. scutiger* from *Hexagrammos otakii* Jordan & Starks caught off Momotori, Mie Prefecture, Japan (Shiino, 1952) and stored in the collections of the Faculty of Fisheries, University of Mie; Reg. No. Parasitic Copepoda 116.

Remarks. Shiino's type material comprises 5♀♀. A lectotype ♀ (the specimen dissected and figured by Shiino) and 3♀♀ paralectotypes are here designated. The remaining ♀ from the series is, in our opinion, significantly different from *L. scutiger* and becomes the holotype of a new species, *L. sheni*, described below. *L. scutiger* has only been recorded from Japanese waters; the records of Shen (1958) and Hewitt (1963) are regarded as referring to *L. sheni* sp.nov. and *L. erecsoni* respectively.

L. scutiger differs from *L. erecsoni* primarily in the absence of posterolateral lobes on the genital complex in the female and in the relatively small size of the fourth leg which does not extend beyond the posterior margin of the genital complex. The first segment of the fourth leg is less robust than in *L. erecsoni* and does not extend beyond the 'shoulders' of the genital complex. Other differences include the relatively shorter broader abdomen, the broader fifth leg and the more divergent tines on the first maxilla in *L. scutiger*.

***Lepeophtheirus sheni* sp.nov (Fig. 5)**

Lepeophtheirus scutiger: Shen 1958: 139-140, pl. I.

Adult female. Dorsal shield (Fig. 5A) subcircular, with broad posterior sinuses. Lateral zones of dorsal shield with bifid cuticular rib on ventral surface. Genital complex wider than long, with parallel lateral margins, posterior margins slightly rounded but without posterolateral lobes. Abdomen (Fig. 5B) 1-segmented, wider than long and with much straighter posterior margin than *L. scutiger*. Caudal rami longer than wide, armature elements similar to those of *L. erecsoni*.

Appendages similar to those of *L. erecsoni* in segmentation and basic armature elements, differences in armature given below. First antenna segment 1 with slightly concave posterior margin bearing a single minute process distally as in *L. scutiger*. Second antenna (Fig. 5C) terminal segment with proximal tine-like process on ventral surface and slender seta on anterior margin. First maxilla (Fig. 5D) tines set further apart at base producing a more divergent appearance than in *L. scutiger*. Second maxilla canna with conspicuous barb on convex margin and serrated membranes along concave margin. Sternal furca (Fig. 5E) tines divergent, straight and with small bilateral flanges. First leg with similar armature elements on distal tip of exopod (Fig. 5F) to those of *L. erecsoni* except spines 2 and 3 each have an additional row of fine spinules on their ventral surfaces near convex margin. Fourth leg (Fig. 5G) much shorter than genital complex and with first segment not extending beyond 'shoulders' of genital complex (Fig. 5A). Fifth leg (Fig. 5H) with conical process bearing 3 plumose setae well separated from lateral papilla bearing single apical plumose seta.

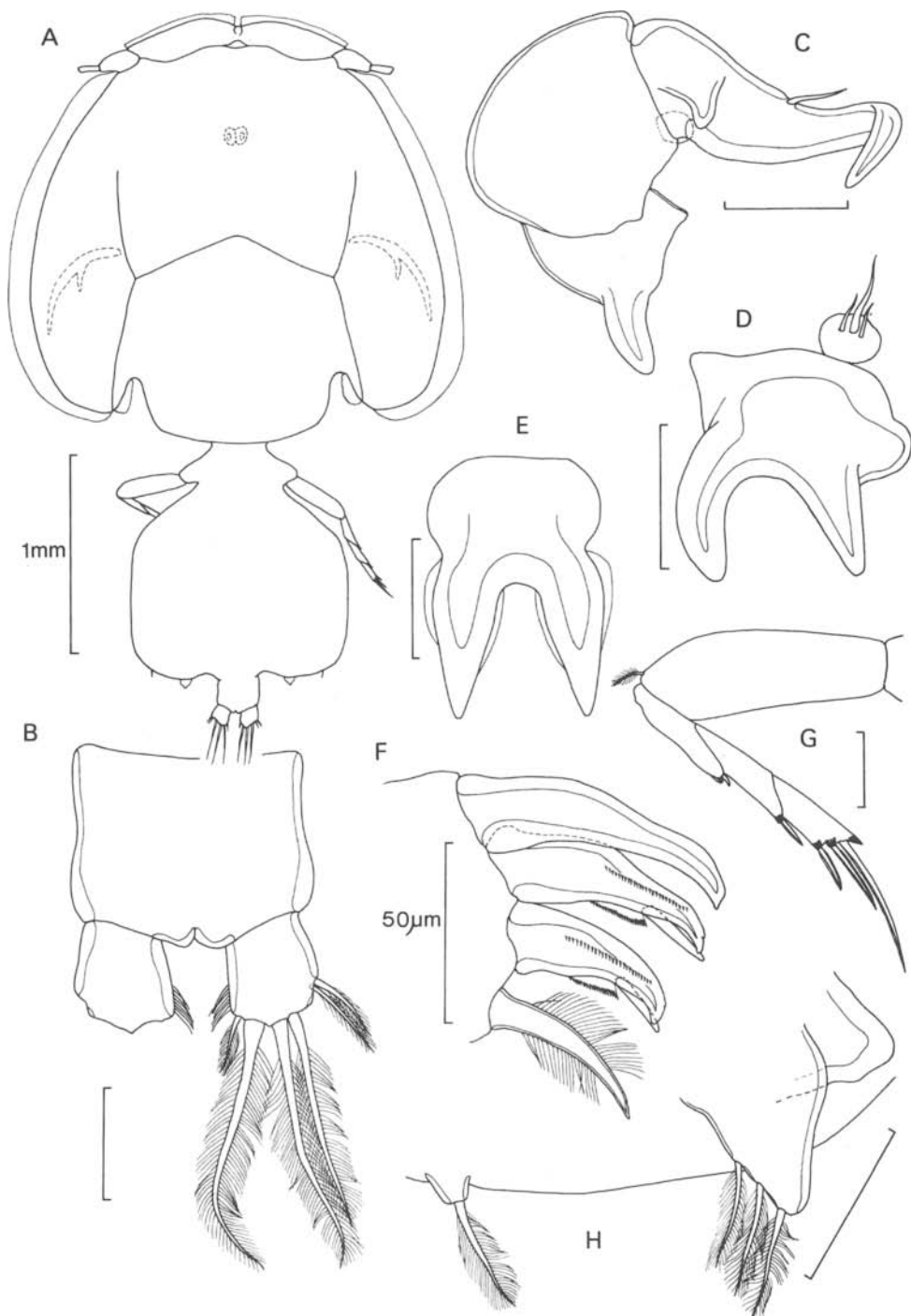


Fig. 5 — *Lepeophtheirus sheni* sp. nov. Holotype female. A, dorsal (with third legs omitted for clarity); B, abdomen, ventral; C, second antenna, ventral; D, first maxilla, ventral; E, sternal furca, anteroventral; F, tip of first leg exopod, ventral; G, fourth leg, ventral; H, fifth leg, ventral. Scale 100 μ m unless otherwise stated.

Body length of holotype female 3.57 mm. Body length of Shen's (1958) material ranging from 3.6 to 4.58 mm.

Male unknown.

Material examined. Holotype ♀ of *Lepeophtheirus sheni* removed from syntype series of *L. scutigera*, obtained from *Hexagrammos otakii* caught off Momotori, Mie Prefecture, Japan (Shiino, 1952) and stored in the collections of the Faculty of Fisheries, University of Mie; Reg. No. 702.

Remarks. The new species is closely related to *L. scutigera* but can be distinguished from it by the shape of the genital complex, the shape of the abdomen, which has a straighter posterior margin than in *L. scutigera*, and by the shape of the caudal rami. The presence of the tine-like process on the proximal portion of the terminal segment of the second antenna is a distinctive attribute of *L. sheni*, and there are differences also in the shape of the first maxilla, sternal furca and fifth leg. The ventral cuticular ribs on the lateral zones of the dorsal shield are forked in the new species whereas these ribs are simple in both *L. erecsoni* and *L. scutigera*. This character is readily observable and may prove to be a useful taxonomic character throughout the genus.

The material described by Shen (1958) as *L. scutigera* is referable to the new species on the basis of the characters mentioned above (particularly the shape of the caudal rami and abdomen, the bifurcate cuticular rib and the tine on the claw of the second antenna), and it is named after him. The proportions of the abdomen of the specimen illustrated by Shen (1958; pl. I, Fig. 2) differ from those of the holotype female (Fig. 5B), but this is probably due to the difficulty in observing the exact position of the suture line in ventral view. The shape of the abdomen indicated in Shen's dorsal view (1958; pl. 1, Fig. 1) corresponds closely to that of the holotype.

KEY TO FEMALE *Lepeophtheirus*

The three species of *Lepeophtheirus* from the Indo-Pacific described in this account, *L. erecsoni*, *L. scutigera* and *L. sheni*, resemble each other closely, and many of the differences between them, such as the degree of divergence of paired tines, are difficult to assess without comparative material being available. However, the females of all three species can be separated using the following key:

1. Second antenna with proximal tine-like process on ventral surface of terminal segment; ventral rib on lateral zone of dorsal shield bifid; caudal rami wider than long *L. sheni* sp. nov.
- Second antenna without proximal tine-like process on terminal segment; ventral rib on lateral zone of dorsal shield simple; caudal rami longer than wide 2
2. Genital complex with well-developed posterolateral lobes; fourth leg relatively long, extending beyond posterior margin of genital complex *L. erecsoni*
- Genital complex without posterolateral lobes; fourth leg relatively short, not extending as far as posterior margin of genital complex *L. scutigera*

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