



REDESCRIPTION OF *PUMILIOPEs SCOMBRI* IZAWA, 2021 (COPEPODA, CYCLOPOIDA, BOMOLOCHIDAE) RECOVERED FROM *SCOMBER JAPONICUS* HOUTTUYN, 1782 (ACTINOPTERYGII) IN JAPAN, WITH DESCRIPTION OF THE MALE OF THE SPECIES

BY

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ABSTRACT

*Pumiliopes scombri* Izawa, 2021 is redescribed based on specimens of both sexes recovered from the bucco-branchial cavity of the chub mackerel, *Scomber japonicus* Houttuyn, 1782 (Scombriformes, Scombridae), in Japan. The male of the species is described for the first time. The description of the male is also the first time for the genus. This genus is unique in having an antenna that is sexually dimorphic.

Key words. — Parasitic copepods, Cyclopoida, Bomolochidae, sexually dimorphic antenna, Actinopterygii, chub mackerel

RÉSUMÉ

*Pumiliopes scombri* Izawa, 2021 est redécrit à partir de spécimens des deux sexes collectés dans la cavité bucco-branchiale du maquereau espagnol *Scomber japonicus* Houttuyn, 1782 (Scombriformes, Scombridae), au Japon. Le mâle de l'espèce est décrit pour la première fois. La description du mâle est aussi la première fois pour le genre. Ce genre est unique par son antenne sexuellement dimorphique.

Mots clés. — Copépodes parasites, Cyclopoida, Bomolochidae, antenne sexuellement dimorphique, Actinopterygii, maquereau espagnol

INTRODUCTION

*Pumiliopes scombri* Izawa, 2021 is redescribed based on specimens of both sexes recovered from the bucco-branchial cavity of the chub mackerel, *Scomber japonicus* Houttuyn, 1782 (Scombriformes, Scombridae), in Japan. The male of

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the species is described for the first time. The description of the male is also the first time for the genus. This genus is unique in having an antenna that is sexually dimorphic.

#### MATERIAL AND METHODS

Specimens recovered from hosts were fixed in formalin and preserved in 70% alcohol. The specimens were stained with chlorazol black E in lactic acid and examined with a differential interference contrast microscope using the “wooden slide method” of Humes & Gooding (1964). Drawings were made with the aid of a drawing tube. The terminology for copepod morphology is based on Huys & Boxshall (1991). Common and scientific names of the hosts follow Froese & Pauly (2023). The specimens were deposited in the National Museum of Nature and Science, Tsukuba (NSMT).

#### TAXONOMIC DESCRIPTIONS

##### ***Pumiliopes scombri* Izawa, 2021 (figs. 1-4)**

*Pumiliopes scombri* Izawa, 2021: 86-89, figs. 7-8.

Material examined.— One female and 2 males, recovered from the bucco-branchial cavity of the chub mackerel, *Scomber japonicus* Houttuyn, 1782, in the Sea of Kumano, Mie prefecture, on 28 September 2022 (NSMT K-901).

Female (figs. 1-2).— Habitus (fig. 1A), body length excluding caudal rami 1.76 mm ( $n = 1$ ), cephalothorax  $0.75 \times 0.95$  mm. Width ratios of pedigers 2-4 to cephalothorax 0.57, 0.44, and 0.33, respectively. Genital somite about 2.1 times as wide as long, with leg 6 in dorsolateral gonopore of each side (fig. 1F, p6), represented by small lobe tipped by 3 setae. Abdomen 3-segmented, anal somite about 2 times as wide as long, spinulose ventrally (fig. 1G). Caudal ramus (fig. 1G) about 1.7 times as long as wide, spinulose ventrally, with 6 setae including 1 major seta (fig. 1G). Egg sac  $1.05 \times 0.44$  mm ( $n = 1$ ).

Rostral plate (fig. 1B, r) convex anteriorly, without ventral processes. Antennule (fig. 1B) 6-segmented, first segment forming pedestal, number of setal elements per segment (base to apex) as follows: 0, 5, 10 + 7, 4, 3, 8. Antenna (fig. 1C) sexually dimorphic, 5-segmented, first segment unarmed, second with distal seta, third with medial seta, fourth tapered distally to form claw-like process, with comb-plate and simple seta anteriorly, fifth with 4 hook-like setae distally.

Mouthparts (fig. 1D), labrum (lr) tuberculose ventrally; mandible (md) with 2 blades; paragnath (p) thumb-shaped, pectinate on distal lobe; maxillule (mx1) with 3 setae; maxilla (mx2) 2-segmented, second segment with setula distally, tipped

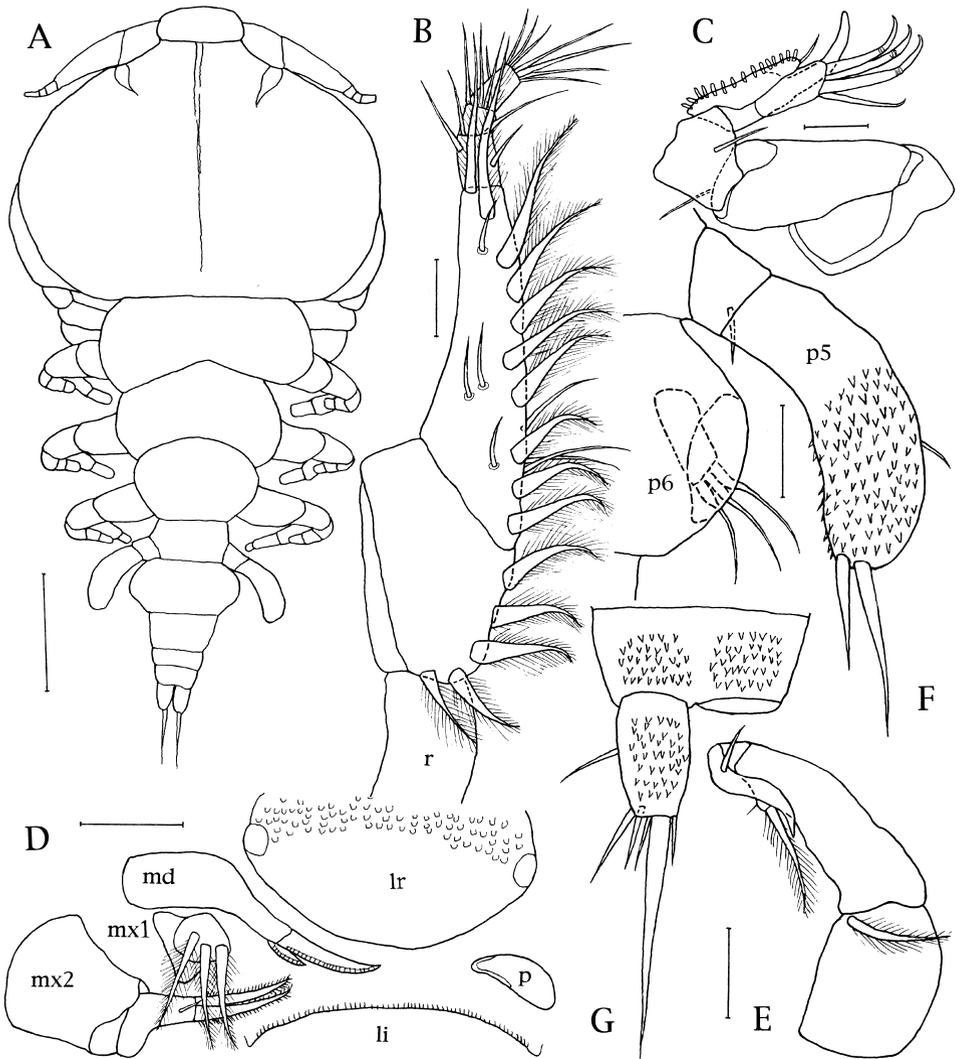


Fig. 1. *Pumiliope scombri* Izawa, 2021, female. A, Habitus, dorsal; B, rostral plate and antennule, dorsal; C, antenna, ventral; D, mouthparts, ventral; E, maxilliped, ventral; F, legs 5 and 6, ventral; G, anal somite and caudal ramus, ventral. Abbreviations: li, labium; lr, labrum; md, mandible; mx1, maxillule; mx2, maxilla; p, paragnath; p5, leg 5; p6, leg 6; r, rostral plate. Scale bars: 0.3 mm for A; 0.05 mm for B, D-G; 0.03 mm for C.

by 2 pectinate processes; labium (li) spinulose on distal margin. Lateral process absent. Maxilliped (fig. 1E) 3-segmented, syncoxa with seta medially, basis tapered distally, with setula and seta mediodistally, endopod forming recurved claw, claw with seta proximally.

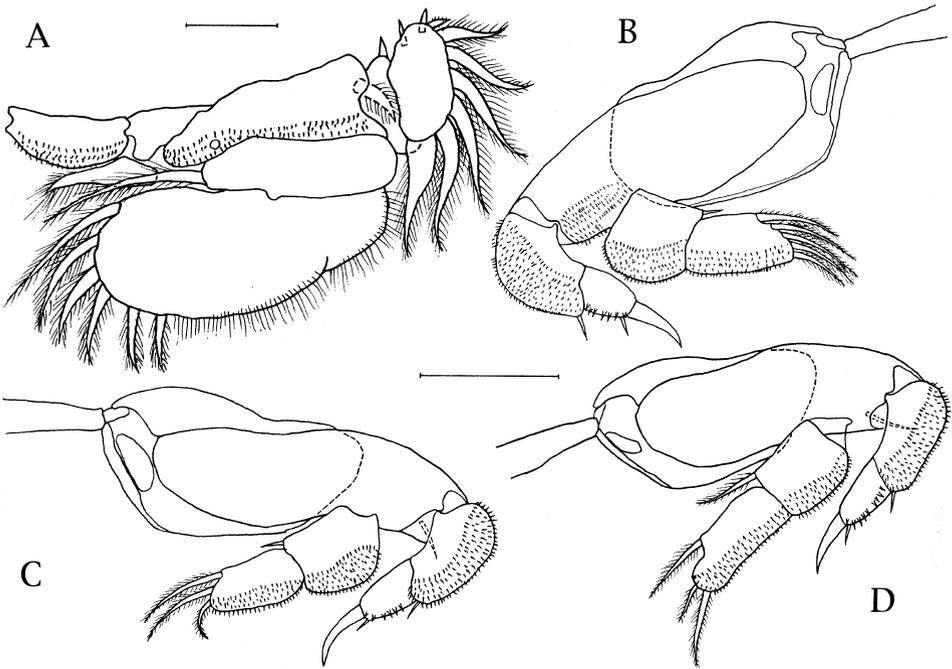


Fig. 2. *Pumiliopes scombri* Izawa, 2021, female. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bars: 0.1 mm; shorter bar upper left, for A; longer bar in middle, for B-D.

Legs 1-4 (fig. 2A-D) each with intercoxal plate, biramous, rami 2-segmented in leg 1, exopod 3-segmented and endopod 2-segmented in legs 2-4. Formulae for spines (Roman numerals) and setae (Arabic numerals) of these legs as follows:

- Leg 1 coxa 0-1 basis 1-1 exopod I-0; III, 6 endopod 0-1; 0-1; 6
- Leg 2 coxa 0-0 basis 1-0 exopod I-0; I-1; I endopod 0-1; 5
- Leg 3 coxa 0-0 basis 1-0 exopod I-0; I-0; I endopod 0-1; 3
- Leg 4 coxa 0-0 basis 1-0 exopod I-0; I-0; I endopod 0-1; 3

Medial seta of leg 1 basis atrophied, lateral spines of exopod segments 1 and 2 minute in legs 2-4, exopod segment 3 forming claw in legs 2-4. Leg 5 (fig. 1F, p5) 2-segmented, first segment with dorsodistal seta, second segment about 3 times as long as wide, spinulose ventrodistally, with 3 setal elements.

Male (figs. 3-4).— Habitus (fig. 3A), body length excluding caudal rami 0.64-0.65 mm ( $n = 2$ ), cephalothorax,  $0.29 \times 0.25$  mm, pedigers 2-4 successively decreasing in width, genital somite fused to pediger 5, about 1.3 times as long as wide, with genital slits ventrodistally. Abdomen 2-segmented (fig. 3F) spinulose ventrally, anal somite about 1.3 times as wide as long. Caudal ramus (fig. 3F) about 1.5 times as long as wide, with 6 setae including 1 major seta, which is 46% of body length.

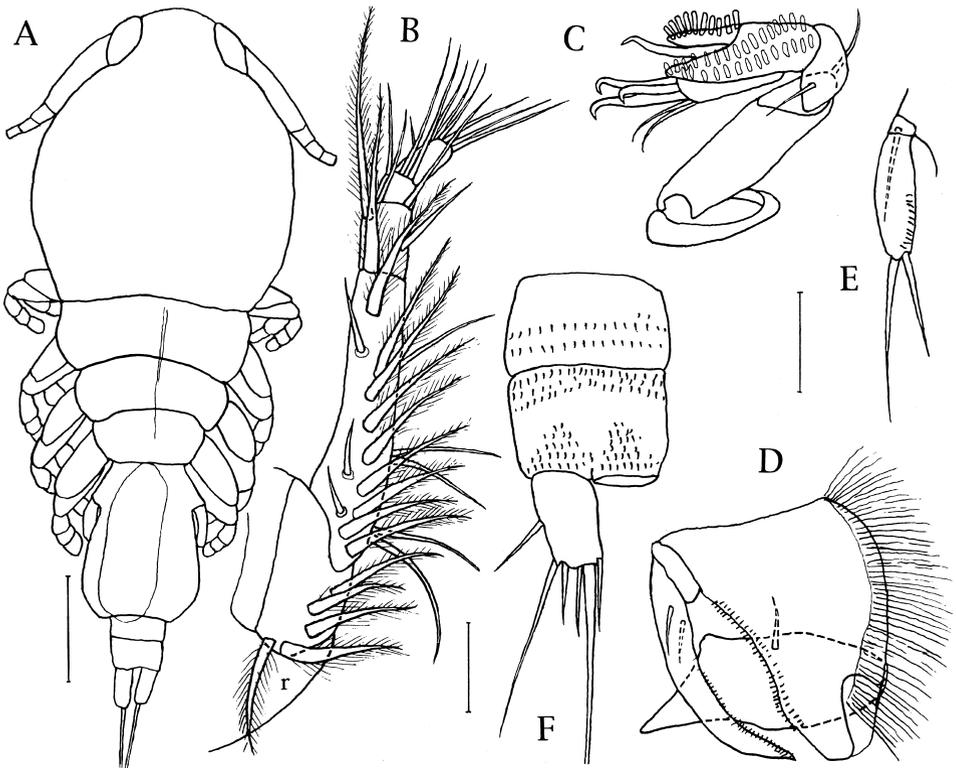


Fig. 3. *Pumiliopes scombri* Izawa, 2021, male. A, Habitus, dorsal; B, rostral plate and antennule, ventral; C, antenna, ventral; D, maxilliped, ventral; E, leg 5, ventral; F abdominal somites and caudal ramus, ventral. Scale bars: 0.1 mm for A; 0.03 mm for B-F.

Rostral plate (fig. 3B) gently rounded anteriorly, without ventral processes. Antennule (fig. 3B) sexually dimorphic, 6-segmented, first segment forming pedestal, number of setal elements per segment (base to apex) as follows: 0, 5, 10 + 8, 1 + 3, 3, 7. Antenna (fig. 3C) of usual form for Bomolochidae; 5-segmented, first segment unarmed, second with distal seta, third narrowed distally, spinulose ventrally, with comb-plate and hook-like seta anteriorly, fifth with 3 hook-like setae and 2 simple setae distally.

Mouthparts (not illustrated) almost as in female. Maxilliped (fig. 3D) sexually dimorphic, subchelate, 3-segmented, syncoxa with anterior seta, basis broadened proximally, with sinus on proximal margin and row of cilia each on ventral and dorsal margin proximally, tuberculose along inner margin, endopod forming claw, claw notched on inner margin, with 2 setae proximally.

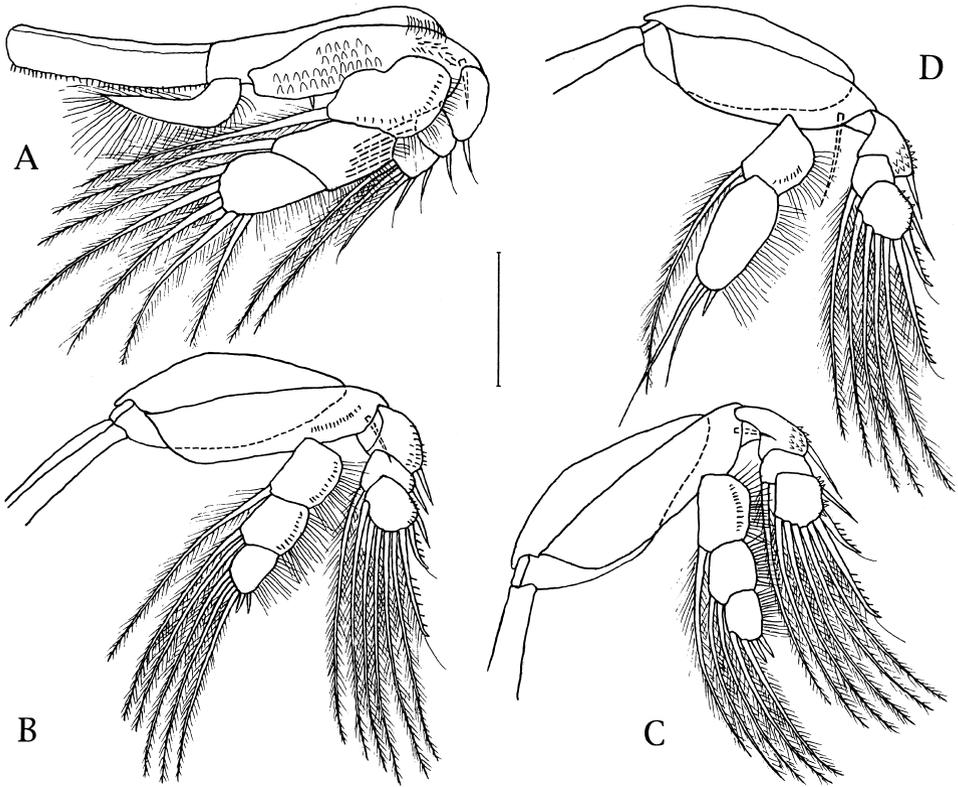


Fig. 4. *Pumiliopes scombri* Izawa, 2021, male. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.05 mm.

Legs 1-4 (fig. 4) each with intercoxal plate, biramous, rami 3-segmented except 2-segmented endopod of leg 4. Formulae for spines (Roman numerals) and setae (Arabic numerals) of these legs as follows:

Leg 1 coxa 0-1 basis 1-1 exopod I-0; I-1; II, I, 4 endopod 0-1; 0-1; I, 5

Leg 2 coxa 0-0 basis 1-0 exopod I-0; I-1; II, I, 5 endopod 0-1; 0-2; II, 3

Leg 3 coxa 0-0 basis 1-0 exopod I-0; 0-1; II, I, 5 endopod 0-1; 0-2; II, 2

Leg 4 coxa 0-0 basis 1-0 exopod I-0; 0-1; II, I, 4 endopod 0-1; I, 2

Lateral spines of leg 1 exopod, lateral spines of exopod segment 1 of legs 2-4, lateral spines of exopod segment 2 of legs 2 and 3, and first lateral spines of exopod segment 3 of legs 2-4 simple, second spines of exopod segment 3 of legs 2-4 pectinate laterally, tipped with flagella, distal spines of exopod segment 3 of legs 1-4 pectinate laterally, pinnate medially, tipped with flagella, distal spines of endopod segments of legs 2-4 simple. Leg 5 (fig. 3E) 2-segmented, first segment

with dorsodistal seta, second segment about 3 times as long as wide, with 2 distal setae.

Remarks.— The genus *Pumiliopes* Shen, 1957 consists of five species (cf. Walter & Boxshall, 2023): they are *P. capitulatus* Cressey & Boyle, 1973 recovered from *Konosirus punctatus* (Temminck & Schlegel, 1846) (Clupeiformes, Clupeidae) (cf. Cressey & Boyle, 1973); *P. jonesi* (Bennet, 1968) from *Rastrelliger kanagurta* (Cuvier, 1816) (Scombriformes, Scombridae) (cf. Bennet, 1968); *P. opisthopteri* Shen, 1957 from *Opisthopterus tadoore* (Cuvier, 1829) (Clupeiformes, Pristagasteridae) (cf. Shen, 1957); *P. scombri* Izawa, 2021, from *Scomber australasicus* Cuvier, 1832 and *S. japonicus* Houttuyn, 1782 (Scombriformes, Scombridae) (cf. Izawa, 2021); and *P. squamosus* (Cressey & Boyle, 1973) from *Sardinella zunasi* (Bleeker, 1854) (Clupeiformes, Clupeidae) (cf. Cressey & Boyle, 1973).

This genus is unique in having a modified antenna in the female, of which the fourth segment is narrowed distally to form a claw as seen in *P. capitulatus* (cf. Cressey & Boyle, 1973, fig. 5), *P. jonesi* (cf. Bennet, 1968, fig. 1C), *P. opisthopteri* (cf. Shen, 1957, fig. 85), *P. scombri* (cf. Izawa, 2021, fig. 7F; this paper, fig. 1C), and *P. squamosus* (cf. Cressey & Boyle, 1973, fig. 17).

The description of the male in this paper is the first time for the genus. As shown in the male of *P. scombri*, the male antenna is of the usual form for the family (this paper, fig. 3C), thus the antenna is sexually dimorphic in the genus.

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