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A New Species of *Pseudanthessius* (Copepoda: Cyclopoida: Pseudanthessiidae) on *Epinephelus* sp. (Actinopterygii: Perciformes: Serranidae) from Chuuk Lagoon, Federated States of Micronesia

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A copepod, *Pseudanthessius chuukensis* Uyeno, n. sp. (Cyclopoida: Pseudanthessiidae), is described based on the type specimen obtained from the grouper *Epinephelus* sp. (Actinopterygii: Perciformes: Serranidae) caught in Chuuk Lagoon (North Pacific Ocean), Federated States of Micronesia, North Pacific Ocean. The copepod differs from its congeners in the following female characters: the urosome is 5-segmented; caudal rami are five to six times longer than wide; the distal endopodal segment of leg 1 carries three spines and three setae; leg 4 endopod has two setae, without proximal swellings, and as long as about two-third of that of the exopod. This finding of the copepod is the first record of the family Pseudanthessiidae from the actinopterygian fish.

Key Words: Pseudanthessiidae, copepod, new species, Chuuk, Micronesia, Actinopterygii.

Introduction

Pseudanthessiidae (Cyclopoida) is one of the copepod families associated with various marine invertebrates (Boxshall and Halsey 2004). Among the five genera of the family, *Senariellus* Humes, 1977 and *Mecomerinx* Humes, 1977 occur on echinoids, and *Sipadania* Humes and Lane, 1993 appears on asteroids (Humes 1977; Humes and Lane 1993). Further, *Spiranthessius* Stock, 1995 and *Tubiporicola* Kim, 2009 were found from serpulid polychaetes and stoloniferan corals, respectively (Stock 1995; Kim 2009). *Pseudanthessius* Claus, 1889, the largest genus of the family, utilize various hosts, e.g., poriferans, turbellarians, gastropods, and polychaetes, but nearly half of the members were found from echinoderms (e.g., Humes and Stock 1973). In this study, *Pseudanthessius chuukensis* n. sp. is described based on the specimen found on the grouper *Epinephelus* sp. (Actinopterygii: Perciformes: Serranidae) caught from Chuuk Lagoon (North Pacific Ocean), Federated States of Micronesia (FSM), the North Pacific Ocean.

Materials and Methods

The copepod specimen was taken from the grouper (Fig. 1) caught by local fishermen by spears and then fixed in 80% ethanol. Subsequently, the copepod was soaked in lactophenol for 24 h, dissected using sharpened tungsten needles, and examined using a modified version of the wooden slide method of Humes and Gooding (1964). Drawings were made with the aid of a drawing tube. The copepod body parts were measured using an ocular micrometer and measurements are given in micrometers (μm). The body length was measured from the frontal margin of cephalothorax to the distal tip of caudal rami without setae. The field survey, material's examination, and its deposition were permitted by The Chuuk Department of Marine Resources, Chuuk State Government, Federated States of Micronesia. Type specimen has been deposited in the Invertebrate Zoology collection of the Bernice Pauahi Bishop Museum (BPBM), Honolulu, Hawai'i.

Taxonomic Accounts

Genus ***Pseudanthessius*** Claus, 1889
Pseudanthessius chuukensis Uyeno, n. sp.
(Figs 2–4)

Type material. Holotype: 1 adult female (BPBM-S18653), ex *Epinephelus* sp. [probably *E. macrospilos* (Bleeker, 1855)] (Perciformes: Serranidae) (Fig. 1), off western coast of Piis-Paneu Island (7°40′N, 151°45′E), Chuuk, FSM, North Pacific Ocean, 23 August 2016.

Adult female. Body (Fig. 2A) cyclopiform, 1743 long, depressed dorsoventrally with greatest width at cephalosome.

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Fig. 1. A grouper, *Epinephelus* sp. [probably *E. macrospilos* (Bleeker, 1855)], from which the holotype of *Pseudanthessius chuukensis* Uyeno, n. sp. was found in Chuuk Lagoon, FSM. Scale bar: 50 mm.

Cephalosome, wider than long, 278×403. First to fourth pedigerous somites and urosomites free. Prosome 703 long. Genital double somite (Fig. 2A, B) longer than wide, 215×176. Abdomen composed of three free somites, 178×162, 164×150, and 131×140, respectively. Caudal ramus (Fig. 2A, C) 5.69 times longer than wide, 287×51, with six setae.

Rostrum (Fig. 2D) triangular, bearing distinct apex with blunt margin. Antennule (Fig. 2E) 7-segmented; armature formula 5, 14, 4, 3, 4+1 aesthetasc, 2+1 aesthetasc, 7+1 aesthetasc; all setae naked. Antenna (Fig. 3A) 4-segmented, composed of coxobasis and 3-segmented endopod; coxobasis large, bearing single naked seta; first endopodal segment bearing simple median seta on inner margin; second endopodal segment bearing three inner setae; third endopodal segment 0.73 times longer than wide, 27×37, bearing one proximal seta and three robust and one elongate claws and two setae on distal part. Labrum (Fig. 3B) bearing pair of elongate posterior lobes. Mandible (Fig. 3C) bearing serrated blade with single hyaline outer tooth at base of convex margin. Maxillule (Fig. 3D) represented by simple lobe armed with one inner and three distal setae. Maxilla (Fig. 3E) 2-segmented; basal segment unarmed; distal segment bearing serrated blade and one inner spinulose seta and two naked setae. Maxilliped (Fig. 3F) 3-segmented: syncoxa unarmed; basis with two simple setae; conical endopodal segment with spinulose tip and one large and one small elements. Legs 1 to 4 (Figs 3G, 4A–C) biramous, with 3-segmented rami, except unsegmented leg 4 endopod. Leg armature formula as in Table 1. Intercoxal sclerites (Figs 3G, 4A–C) of legs 1 to 4 unornamented. All spines spatulate with serrated margins. All setae plumose. Rami of legs 1 to 4 bearing pointed projections on outer margins and rows of hair-like setules on both outer and inner margins. Leg 4 endopod (Fig. 4C) unsegmented, 2.74 times longer than wide, with small notch on outer margin. Leg 5 (Fig. 4D) represented by simple spine and two naked setae. Leg 6 (Fig. 2B) represented by two small setae at genital opening.

Infection sites. Gill to buccal cavities.

Remarks. Females of nine congeners [*Pseudanthessius aestheticus* Stock, Humes, and Gooding, 1964, *P. concinnus* Thompson and Scott, 1903, *P. dentatus* Kim, 2000, *P. gracilioides* Sewell, 1949, *P. gracilis* Claus, 1889, *P. latus* Illg, 1950, *P. limatus* Humes, 1978, *P. thorellii* (Brady and Robertson, 1875), and *P. weberi* Scott, 1909] share the 5-segmented urosome and caudal rami which are more than four times longer than wide with *P. chuukensis* n. sp. Of these congeners, *P. concinnus* and *P. thorellii* clearly differ from the new species by having caudal rami which are more than ten times longer than wide (vs. 5.69 times) (e.g., Stock et al. 1964; Humes 1978; Kim 2000). *Pseudanthessius aestheticus*, *P. dentatus*, *P. latus*, and *P. limatus* are distinguished from *P. chuukensis* n. sp. by the leg armature formula: the distal endopodal segment of leg 1 has one spine and five setae in these species (vs. three spines and three setae in the new species); and the endopod of leg 4 has two spines (vs. replaced by two setae in the new species) (Illg 1950; Stock et al. 1964; Humes 1978; Kim 2000). In addition to those two characters, *P. gracilioides* is separated from the new species by having the distal exopodal segment of leg 1 with five inner setae (vs. four setae) and both rami of leg 4 being nearly equal in length (vs. the endopod being about two-thirds as long as the exopod) (Sewell 1949). *Pseudanthessius weberi* and *P. gracilis*, in which the leg armature formula was insufficiently shown in the original descriptions, differ from *P. chuukensis* n. sp. in having the endopod of leg 4 tapering distally with a proximal swelling on the inner margin (vs. not tapering distally without proximal swellings) (Claus 1889; Scott 1909).

Etymology. The specific name of the new species refers to the type locality.

Discussion

Currently, over 40 valid species are recognized in *Pseudanthessius* (Walter and Boxshall 2018; present study). Although almost all species of the genus are associated with invertebrates (e.g., poriferans, turbellarians, gastropods, polychaetes, echinoids, crinoids, and ophiuroids), several species were found free on the sediments or in the water (e.g., Humes and Stock 1973; Kim 2000). The finding of *P. chuukensis* n. sp. represents the first record of the family

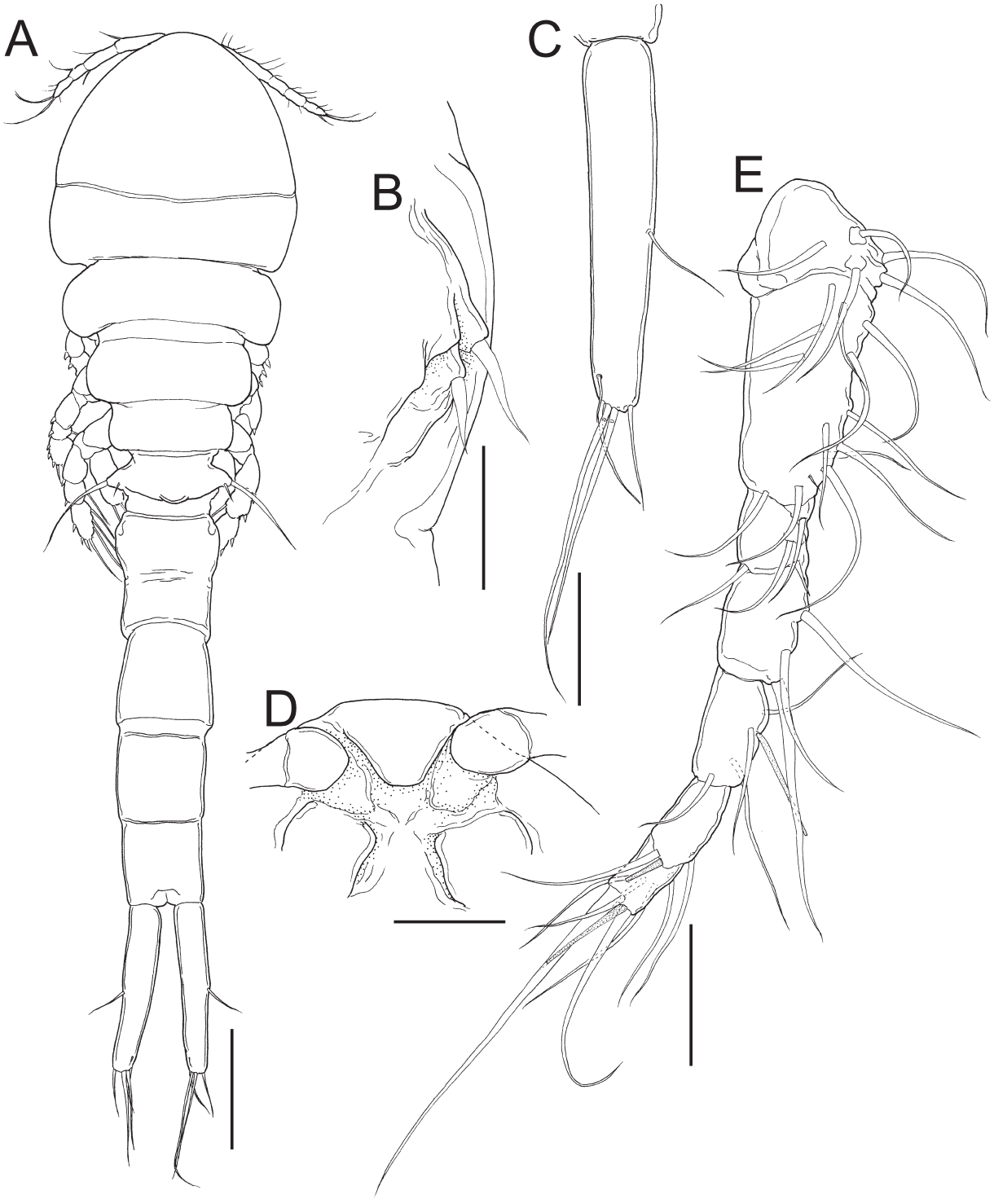

Fig. 2. *Pseudanthessius chuukensis* Uyeno, n. sp., holotype adult female, BPBM-S18653. A, Habitus, dorsal; B, right genital aperture; C, right caudal ramus, dorsal; D, rostral area, ventral; E, right antennule, anterior. Scale bars: A, 200 µm, B, 30 µm; C, 100 µm; D, 50 µm; E, 40 µm.

from vertebrates. In cyclopoid families, several examples of the host switching from invertebrates to actinopterygian fishes are known. For instance, species of the family Anthessiidae are preferentially found from gastropods but *Anthessius lophiomi* Avdeev and Kazachenko, 1986 was found from the blackmouth angler *Lophiomus setigerus* Vahl, 1797 (Lophiiformes: Lophiidae) (Avdeev and Kazachenko 1986). Another cyclopoid family Macrochironidae is commonly found in association with cnidarians. *Paramacrochiron sewelli* Reddiah, 1968, one of the members of the family, was originally described from the scyphozoan jellyfish *Lychnorhiza malayensis* Stiasny, 1920 (Rhizostomeae: Lychnorhizidae) (Reddiah 1968), but it was subsequently recorded from the Atlantic horse mackerel *Trachurus trachurus* (Linnaeus, 1758) (Perciformes: Carangidae) (Avdeev 1975). Hence, the finding of *P. chuukensis* n. sp. from the grouper may be a new example of host switching of the family Pseudanthessiidae from the invertebrate to vertebrate hosts.

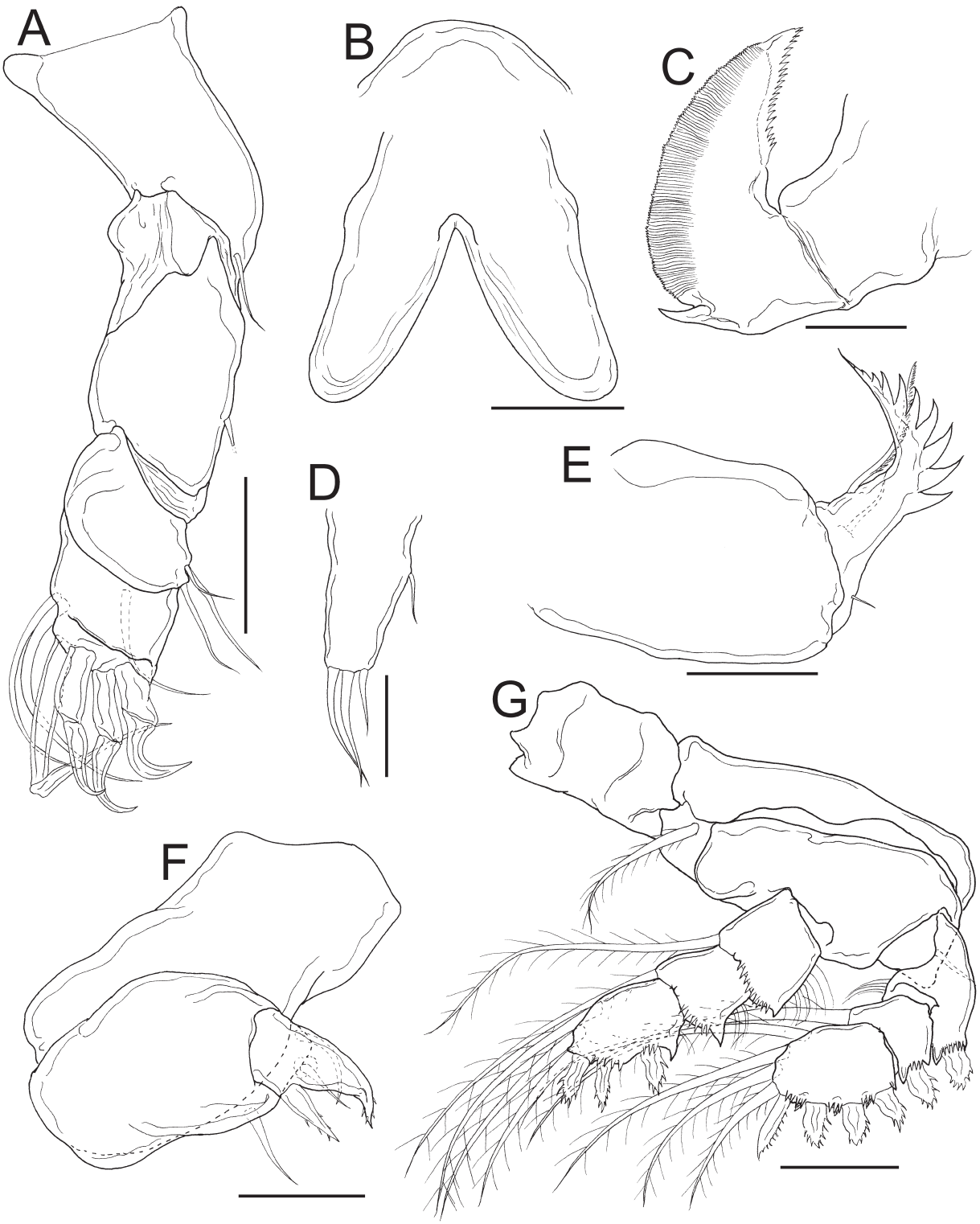

Fig. 3. *Pseudanthessius chuukensis* Uyeno, n. sp., holotype adult female, BPBM-S18653. A, Right antenna, anterior; B, labrum, anterior; C, left mandible, posterior; D, right maxillule, anterior; E, right maxilla, posterior; F, right maxilliped, anterior; G, left leg 1, anterior. Scale bars: A, B, G, 40 μm; C, D, F, 20 μm; E, 30 μm.

On the other hand, it was also possible that the accidental attaching to the host occurred or that the true host was an invertebrate preyed on by the grouper because only one specimen was found in this study. In any case, further study is required to clarify the matter.

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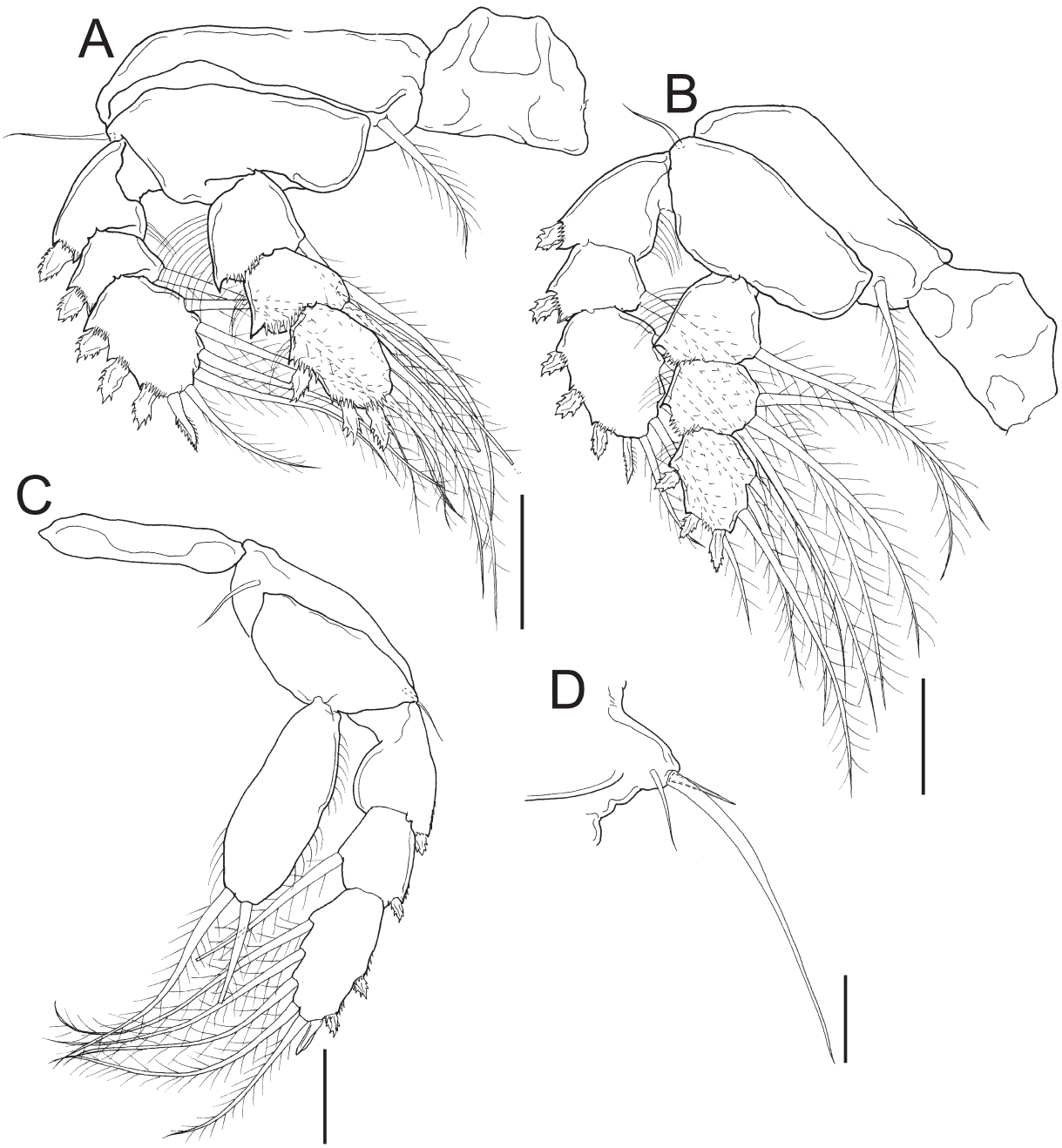

Fig. 4. *Pseudanthessius chuukensis* Uyeno, n. sp., holotype adult female, BPBM-S18653. A, Right leg 2, anterior; B, right leg 3, anterior; C, left leg 4, anterior; D, right leg 5, dorsal. Scale bars: A–D, 50 µm.

Table 1. Armature formula of legs 1 to 4 of *Pseudanthessius chuukensis* Uyeno, n. sp., adult female, BPBM-S18653. Arabic numbers= number of setae, Roman numbers=number of spines.

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	1-0	I-0; I-1; III, I, 4	0-1; 0-1; II, I, 3
Leg 2	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; II, I, 3
Leg 3	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; II, I, 2
Leg 3	0-1	1-0	I-0; I-1; II, I, 5	2

partment of Marine Resources, Chuuk State Government, FSM) for his kind arrangement for the research permission; Benito Nereo and his family for their help and hospitality during the field survey; Tamaki Shimose (Seikai National Fisheries Research Institute) for his valuable comment to identify the grouper and Holly Bolik for her curatorial work to register the type specimen of the new species. Part of this work was supported by the Japan Society for Promotion of

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