

Pseudocharopinus markewitschi (Copepoda: Lernaepodidae) parasitic on a mottled skate, *Beringraja pulchra* (Rajiformes: Rajidae), in the southern Sea of Japan off western Japan

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Abstract

Sixteen adult females of the lernaepodid copepod, *Pseudocharopinus markewitschi* (Gusev, 1951), were collected from the skin of a mottled skate, *Beringraja pulchra* (Liu, 1932), in the southern Sea of Japan off Gotsu, Shimane Prefecture, western Japan. This represents the second record of *P. markewitschi* from the Sea of Japan off the Japanese coast. This note summarizes the published information on the hosts and collection localities of *P. markewitschi*, indicating that the species infects skates of the Rajidae (Rajiformes) and stingrays of the Dasyatidae (Myliobatiformes) in the temperate to subarctic waters of the northern Far East, including the Russian Far East, Japan, Korea, and China. A map of the geographical distribution of *P. markewitschi* is provided.

Introduction

Pseudocharopinus markewitschi was originally described by Gusev (1951) as *Charopinus markewitschi* based on adult females from the ocellate spot skate, *Okamejei kenojei* (Müller and Henle, 1841) (reported as *Raja kenojei*) in Khanton Bay (part of Peter the Great Bay) near Vladivostok, and off Cape Antonovo, southwestern Sakhalin, the Russian Far East. The copepod was later transferred by Kabata (1964) from *Charopinus* to *Pseudocharopinus*. The species has also been reported from China (Song and Kuang, 1980; Ho, 2009), Korea (Kim, 1998), and Japan (Shiino, 1956, 1959; Ho and Kim, 1996). The male of the species was described by Shiino (1959) from Japan.

In 2019, *P. markewitschi* was found to parasitize the mottled skate, *Beringraja pulchra* (Liu, 1932), caught

in the southern Sea of Japan off western Japan. A single record of *P. markewitschi* is present from the Sea of Japan off the Japanese coast (Shiino, 1959), and the present collection is reported herein as the second record of the species from the sea off Japan. This note also summarizes the known hosts and collection localities of *P. markewitschi*.

Materials and Methods

An individual of *B. pulchra* was caught in a fixed net installed in the Sea of Japan off Waki (35°00' 55.0"N 132°11'39.5"E), Gotsu, Shimane Prefecture, western Japan, on 7 February 2019 (Fig. 2, locality 8). The fish was transported alive to the laboratory of the Shimane Aquarium, Hamada, where it was examined for ectoparasites. Copepods were removed from the skin near the gill slits and fixed in 10% formalin or 100% ethanol, and those fixed in 10% formalin were then preserved in 80% ethanol. Later, at the Aquaparasitology Laboratory, Shizuoka Prefecture, copepod specimens were examined for their morphology using an Olympus SZX10 stereo microscope. At present, these specimens are retained at the laboratory for an ongoing taxonomic study of lernaepodid copepods of Japanese marine fishes but will be deposited in the Crustacea collection of the National Museum of Nature and Science, Tsukuba, Ibaraki Prefecture. Morphological terminology follows Kabata (1979). The scientific and common names of fishes mentioned in this paper follow those in FishBase (Froese and Pauly, 2021).

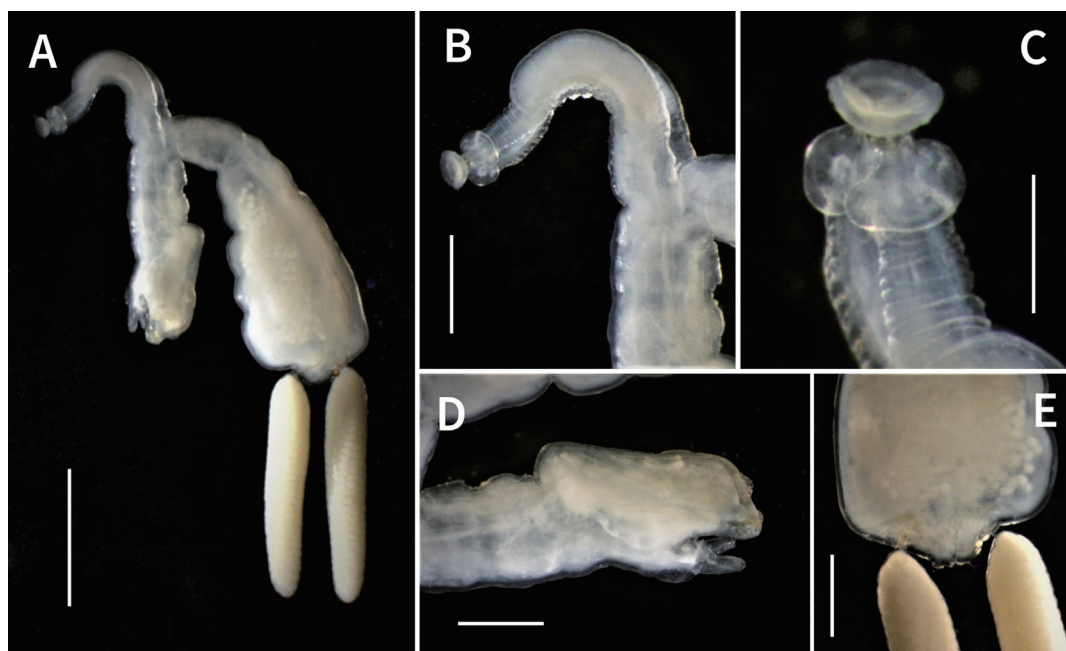


Fig. 1. *Pseudocharopinus markewitschi*, adult female, from a mottled skate, *Beringraja pulchra*, in the southern Sea of Japan off western Japan. A, habitus, dorsolateral view; B, second maxillae, dorsolateral view; C, anterior extremity of second maxillae, dorsal view; D, cephalothorax, lateral view; E, posterior extremity of trunk with a pair of egg sacs, ventral view. Scale bars: A, 3 mm; B, D, E, 1 mm; C, 0.5 mm.

Genus *Pseudocharopinus* Kabata, 1964

[Japanese name: Ei-nagakubi-mushi-zoku, based on Nagasawa and Uyeno (2015)]

Pseudocharopinus markewitschi (Gusev, 1951)

[Japanese name: Ei-nagakubi-mushi, based on Nagasawa and Uyeno (2015)]

(Fig. 1)

Charopinus markewitschi Gusev, 1951: pp. 436–441, figs. 28–29; Shiino, 1956: pp. 280–287, fig. 7; Markevitch, 1956: pp. 388–390, fig. 143 (monograph); Shiino, 1959: pp. 365–366, fig. 14; Yamaguti, 1963: p. 252, pl. 273, fig. 1 (monograph).

Pseudocharopinus markewitschi: Kabata, 1964: pp. 97–98, pl. 8, figs. 57–66; Song and Kuang, 1980: p. 73, unnumbered fig.; Ho and Kim, 1996: p. 300; Kim, 1998: pp. 770–771, fig. 378; Ho, 2009: p. 357, fig. 229 (monograph); Nagasawa and Uyeno, 2015: pp. 138–139 (checklist); Nagasawa, 2021: pp. 19–21, fig. 1 (review).

Occurrence on the host. In total, 16 adult females were found on the skin, near the gill slits, of the mottled skate examined (about 150 cm in total length).

Description. The cephalothorax is cylindrical with

a distinct head covered by a dorsal shield (Fig. 1A, C). The trunk is longer than wide and gradually widens posteriorly (Fig. 1A). Its lateral margins are convex, the posterolateral corners are rounded, and the posterior margin is equipped with an anal tubercle (Fig. 1A, E). The second maxillae are shorter than the trunk, separate from each other but join near the tips: they are transversely wrinkled and slightly taper toward the tips, where a distinct collar-like swelling is present near the base of a small bulla (Fig. 1B, C). A pair of egg sacs, each cylindrical, are attached to the posterior margin of the trunk (Fig. 1A, E).

Measurements of five adult females are as follows: length of trunk 5.0–6.3 (mean, 5.8) mm; of cephalothorax 3.5–4.3 (4.0) mm; of second maxillae 3.0–3.9 (3.5) mm; of egg sacs 4.8–8.1 (6.4) mm.

Remarks. The adult females of the copepod collected were not dissected in this study, but their gross morphology is quite similar to that of *P. markewitschi* reported by Gusev (1951), Shiino (1956), and Kim (1998) and, thus, they are identified as the species.

Two species of *Pseudocharopinus* are known to occur in Japanese waters (Nagasawa and Uyeno, 2015; Nagasawa, 2021): *P. markewitschi* and *P. pteroplataea* (Yamaguti and Yamasu, 1959). The latter species was originally described as *Brachilella pteroplataea* by Ya-

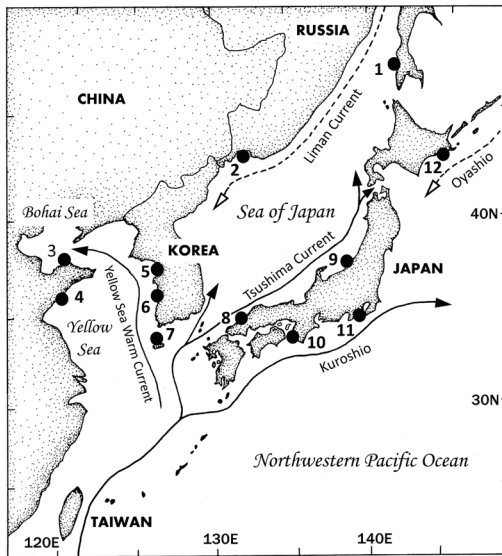


Fig. 2. Map of the Japanese Archipelago and adjacent regions, showing the collection localities (closed circles) of *Pseudocharopinus markewitschi*. 1, Cape Antonovo; 2, Khanton Bay; 3, Bohai Sea; 4, Yellow Sea; 5, Incheon; 6, Buan; 7, Jeju Island; 8, Gotsu; 9, Niigata; 10, Seto; 11, Sagami Bay; 12, Kushiro. Three warm currents (the Kuroshio, the Tsushima Current, and the Yellow Sea Warm Current) and two cold currents (the Oyashio and the Liman Current) are shown by solid and dashed lines, respectively. See the text for the literature.

maguti and Yamasu (1959) from the Japanese butterflyray, *Gymnura japonica* (Temminck and Schlegel, 1850) (as *Pteroplatea japonica*) (Myliobatiformes: Gymnuridae) in Sagami Bay, an inlet of the Northwestern Pacific Ocean, central Japan. These two species are differentiated in the shape of their trunk: a long triangular shape in *P. markewitschi* but an oval shape in *P. pteroplatea*.

To date, *P. markewitschi* has been reported from two localities (Khanton Bay and Antonovo) in the Russian Far East (Gusev, 1951), two localities (Yellow Sea and Bohai Sea off Shandong Province) in China (Song and Kuang, 1980; Ho, 2009), three localities (Jeju Island, Buan, and Incheon) in Korea (Kim, 1998), and five localities (Seto, Sagami Bay, Niigata, Kushiro, and Gotsu) in Japan (Shiino, 1956, 1959; Ho and Kim, 1996; this paper) (Fig. 2). These localities lie in the temperate and subarctic waters, which are principally affected by the warm currents (the Kuroshio, the Tsushima Current, and the Yellow Sea Warm Current) and the cold currents (the Oyashio and the Liman Current), respectively.

The known hosts of *P. markewitschi* include four species of elasmobranchs which belong to two families

in two orders: ocellate spot skate, *O. kenojei* (Gusev, 1951; Shiino, 1959; Kabata, 1964; Kim, 1998, reported as *Raja kenojei*; Song and Kuang, 1980, as *Raja porosa*); mottled skate, *B. pulchra* (Ho and Kim, 1996, as *Raja pulchra*; this paper) (both Rajidae, Rajiformes); brown stingray, *Bathytoshia lata* (Garman, 1880) (Shiino, 1956; Kabata, 1964, as *Dasyatis ush-iei*); and whip stingray, *Hemirtrigon akajei* (Müller and Henle, 1841) (Kim, 1998, as *Dasyatis akajei*) (both Dasyatidae, Myliobatiformes). Attachment sites on the host fish are: the fins (Gusev, 1951; Shiino, 1959; Ho and Kim, 1998), body surface (Gusev, 1951; Shiino, 1959; Kabata, 1964; Song and Kuang, 1980; this paper), and buccal cavity (Shiino, 1956).

Based on the above host list, *P. markewitschi* is not a host-specific parasite and may be found from other skates (Rajidae) and stingrays (Dasyatidae) as well. It is desirable to examine various species of skates and stingrays from different localities in the Russian Far East, Korea, China, and Japan in order to clarify the host utilization and geographical distribution of *P. markewitschi*.

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