

Pedinidae sea urchin, *Caenopedina pulchella* (Echinodermata, Echinoidea), newly recorded from Japanese waters

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Abstract: We described the external features of an echinoid, *Caenopedina pulchella* (A. Agassiz & H. L. Clark, 1907), a rarely encountered species as well as the first record from Japanese waters. The morphological characteristics of three specimens collected off Nagasaki in the East China Sea (depth 384–378 m) in 2012, off Misaki in Sagami Bay (depth 94–100 m) in 2014, and off Toshima in the Izu Islands (depth 370 m) in 2015 were consistent with the previous descriptions. These findings expand the northernmost range of this species in the North Pacific. We proposed a new Japanese standard name, Myoga-gaze, for this species.

Key words: sea urchin, echinoid, *Caenopedina*, new to Japan, external features

Introduction

Sea urchins of the genus *Caenopedina* comprise 13 species (Kroh & Mooi, 2021), many of which are widely distributed in the tropical Indo-Pacific from South Africa to the west coast of the United States and from Japan to New Zealand (Mortensen, 1940; Schultz, 2011). It is also found in the Caribbean Sea and the eastern Pacific Ocean off Panama (Schultz, 2011). Records of this genus in Japanese waters are limited to two species, *Caenopedina mirabilis* (Döderlein, 1885) and *C. indica* (de Meijere, 1903), of which *C. mirabilis* was described in detail by Shigei (1986).

The genus is characterized by a dicyclic apical system with a compact, slightly raised madreporite and tiny uniform periproctal plates. The interambulacral primary tubercles almost cover the entire height of the plates (Mortensen, 1940).

Recently, we collected three specimens of *Caenopedina* from the Japanese waters and identified them as *Caenopedina pulchella* (A. Agassiz & H. L. Clark, 1907). The purpose of this paper is to present the new locality records and describe the external features of *C. pulchella* found for the first time in Japanese waters.

Abbreviations: TD: test diameter; TH: test height; OMNH: Osaka Museum of Natural History.

Genus *Caenopedina* A. Agassiz, 1869

[Japanese name: Otome-gaze-zoku]

***Caenopedina pulchella* (A. Agassiz & H. L. Clark, 1907)**

[New Japanese name: Myoga-gaze]

(Fig. 1)

Hemipedina pulchella A. Agassiz & H. L. Clark, 1907: 245.

Caenopedina pulchella: H. L. Clark, 1912: 223. Pls.91. 18–22; 103. 1–3; 105. 6–7.

Material examined. OMNH-Iv 8457 (EC-519): East China Sea, Japan (32°16.978'N, 129°02.988'E–32°17.217'N, 129°04.665'E), 378–384 m depth; Beam trawl, R/V *Nagasaki Maru*; November 19, 2012 (TD: 17.8 mm, TH: 10.0 mm). OMNH-Iv 8458 (EC-660): Sagami Bay, off Johgashima Island, Misaki, Kanagawa Prefecture, Japan (35°07.840'N, 139°34.453'E–35°07.545'N, 139°34.338'E), 93.6–100 m depth; Marine biology dredge (Rigo Co., Ltd., Tokyo, Japan), R/V *Rinkai Maru*; February 20, 2014 (TD: 10.5 mm, TH: 6.5 mm). OMNH-Iv 8459 (EC-1096): off Toshima Island of the Izu Islands, Tokyo Metropolis, Japan, 370 m depth; the longline fishing; June 21, 2015 (TD: 18.0 mm, TH: 10.0 mm).

Description. The test is small and low; The apical system on the upper surface is gently bulging; the oral side is not sunken towards the peristome. Ambulacra: The width is about half of the interambulacral. The pore-pairs of the ambitus side in arcs of three (Fig. 1A). The primary tubercles are foraminate and have no crenulation at the base (Fig. 1B). Each plate above the ambitus is almost completely covered by a primary tubercle, with only a small space at the corner of each plate for a secondary tubercle. The primary tubercles are slightly smaller in the lower part from the ambitus and are arranged in a regular longitudinal row from the aboral to the oral side. The primary tubercles of interambulacrum are large; secondary tubercles are more numerous than primary tubercles and are coarsely distributed around the areole and at the lateral margins of the test plate.

The apical system is dicyclic and round in outline. The terminal plate is small, about 1/5 in the size of the genital

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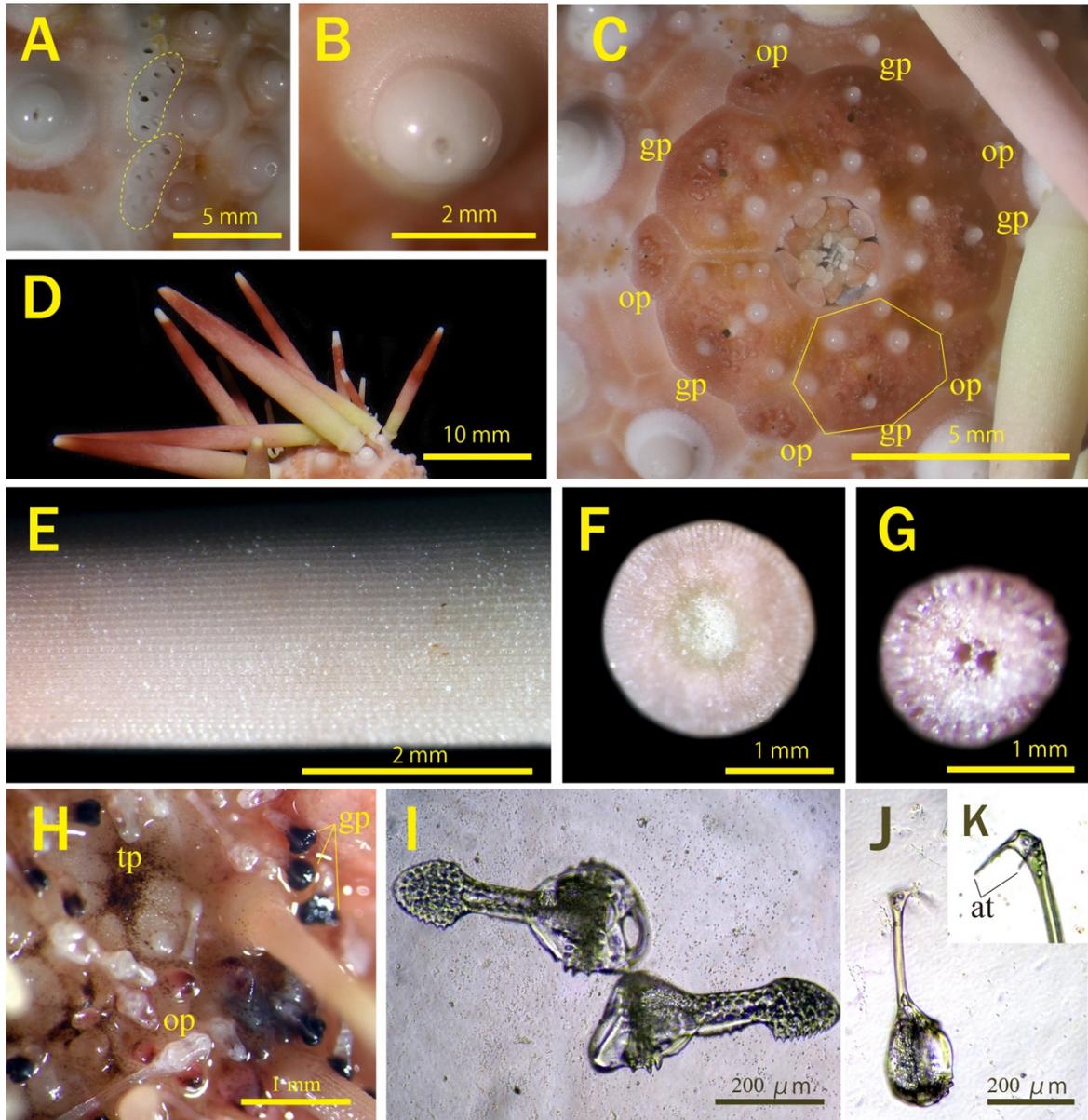


Fig. 1. Detailed morphological characteristics of the specimens of *Caenopedina pulchella* from Japan. A: Ambulacrum plate and pore-pairs. Yellow dotted line: Three ambulacral pore-pairs presented (OMNH-IV 8457). B: Primary tubercle without crenulation (OMNH-IV 8457). C: Apical system. gp: genital plate, op: ocular plate (OMNH-IV 8457). D: Primary spine (OMNH-IV 8457). E: Surface of primary spine (OMNH-IV 8457). F: Cross section of primary spine (OMNH-IV 8457). G: Cross section of secondary spine (OMNH-IV 8457). H: Various species of pedicellaria on the aboral side. gp: Globiferous pedicellaria, op: Ophiocephalus pedicellaria, tp: Tridentate pedicellaria (OMNH-IV 8459). I: Tridentate pedicellaria (OMNH-IV 8459). J-K: Globiferous pedicellaria. At: Apical tooth. (OMNH-IV 8459).

plate, and all of them are located slightly outside of the genital plate. The genital plate is large, heptagonal, and wide. On the genital plate, there are 5–6 large tubercles each, along the inner edge of the plate, which form a ring around the periproctal. The periproctal is composed of variously shaped plates arranged in a paving stone pattern, decreasing in size from the outside to the center (Fig. 1C).

The primary spine is thick and rather stout (Fig. 1D). The shaft of the primary spine is not hollow (Fig. 1F), and the shaft of the secondary spine is hollow (Fig. 1G). All spines are

bluntly tapered, with the larger spines tapering rather abruptly and the smaller ones tapering gradually. Longitudinal striae are very fine and uniform, but quite smooth. The entire spine is completely solid.

All kinds of pedicellariae are present (Fig. 1H). Tridentate pedicellariae: 0.5 mm long, the valves are sometimes broad and flat, but usually narrow and compressed, straight and slightly spaced, or bent and touching only at the tips (Fig. 1I). Globiferous pedicellariae: only aboral them have small black spots (Fig. 1H). The valves have two narrow apical teeth and

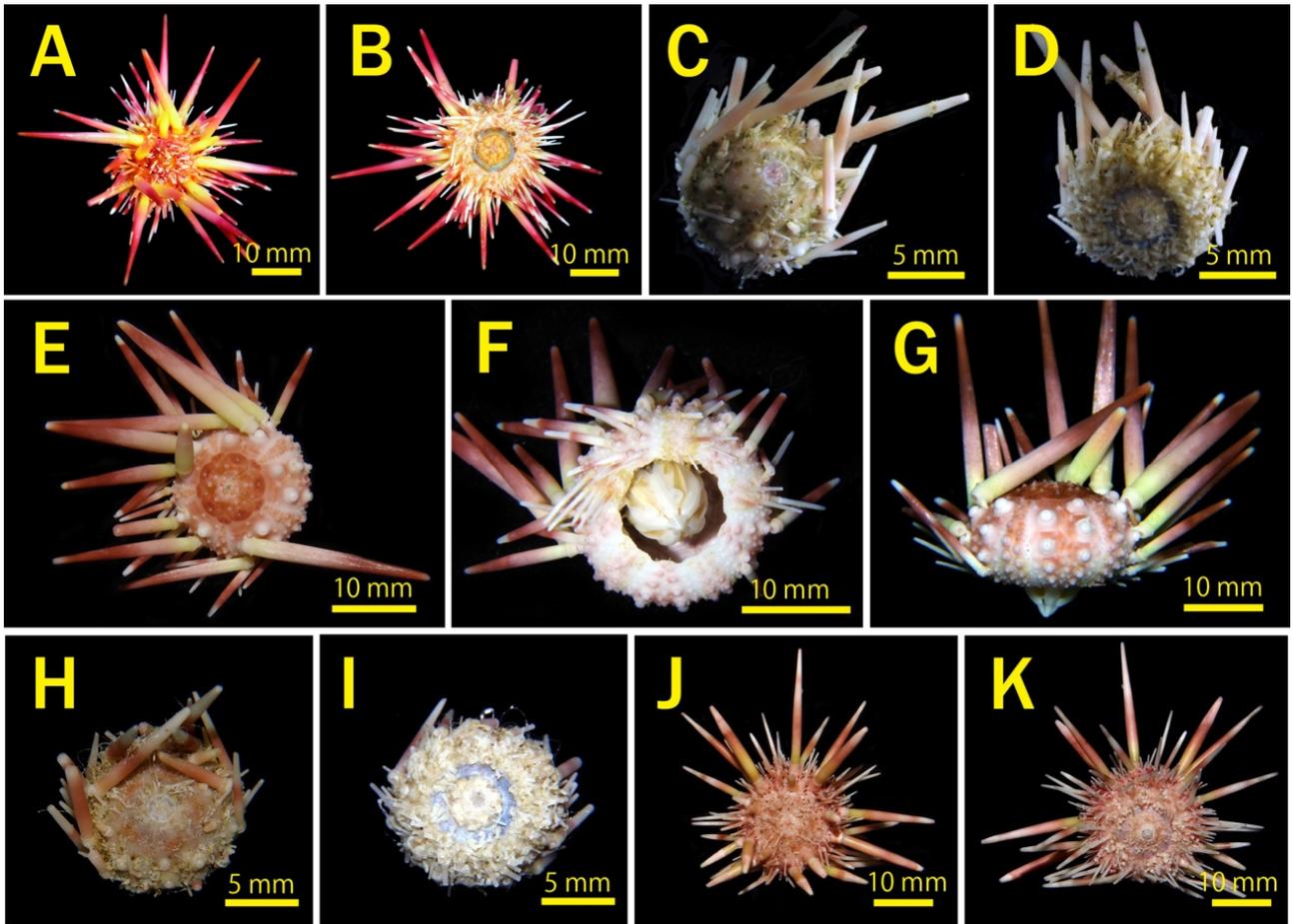


Fig. 2. Living and ethanol preserved specimens of *Caenopedina pulchella* from Japan.

A: Living individual on the aboral side (OMNH-IV 8457). B: Living individual on the oral side (OMNH-IV 8457). C: Living individual on the aboral side (OMNH-IV 8458). D: Living individual on the oral side (OMNH-IV 8458). E: Ethanol preserved specimen on the aboral side. Partially denuded test (OMNH-IV 8457). F: Ethanol preserved specimen on the oral side. Partially denuded test (OMNH-IV 8457). G: Ethanol preserved specimen on the side. Partially denuded test (OMNH-IV 8457). H: Ethanol preserved specimen on the aboral side (OMNH-IV 8458). I: Ethanol preserved specimen on the oral side (OMNH-IV 8458). J: Ethanol preserved specimen on the aboral side (OMNH-IV 8459). K: Ethanol preserved specimen on the oral side (OMNH-IV 8459).

no small spine on the lateral margin (Fig. 1J–K).

Body color. The primary spine is pale yellowish white and pale yellowish greenish-white at the base, bright pink (peony) or pale pink in the middle or from the middle to the tip, and white at the tip (Fig. 2A–D). In alive, these colors are vivid and recognizable, but some individuals such coloration is faint and difficult to recognize even in alive status (Figs. 2A–D). OMNH-IV 8459 was seen only in ethanol specimen, but the primary spine has two pink bands in the middle and one pink band at the tip (Figs. 2J–K); the secondary spine has one light-colored monochromatic or pink band (Figs. 2B, D); periproctal is clear pink with globiferous pedicellariae as small black spots only on the aboral side (Figs. 2A, J); denuded test is pale pink and the main verruca is white. The denuded test is pale pink, the primary tubercle is white, the apical system is dark and the tubercle is pale (Figs. 2E–G).

The coloration of this species is vivid, as seen in the ethanol

specimens: the genital and terminal plates are deep brownish-rose. The large primary spine is pale green at the base, dull rose-red in the terminal half, and pale with little or no white at the tip. The secondary spine on the oral girdle is almost white, with occasional reddish tinge in one or two bands (Figs. 2E–K).

Distribution. Recorded from 370–530 m depth in northern New Zealand, Three Kings Ridge, Colville Ridge, and Johnston Atoll off Hawaii and in the North Pacific (Tracey *et al.*, 2011). It is also distributed off Nagasaki, in the East China Sea, off Toshima in the Izu Islands, and in the waters around Japan off Johgashima in Sagami Bay at depths of 93.6–384 m (this study).

Etymology. The word “myoga” in the new Japanese name meaning “Japanese ginger” derived from the spine of this species that resembles the spike of the “Japanese ginger”. “Gaze” means sea urchin in Japanese.

Remarks. H. L. Clark (1912) and Mortensen (1940) mentioned that the thick primary spine and proportions of this species are reminiscent of genus *Echinometra*; however, the fine morphology of this species indicates that it belongs to the genus *Caenopedina*.

Although it is not a certain record, this species was possibly recorded from Japan. H. L. Clark (1912) collected two specimens of this species from off Kauai Island (Hawaii). Afterwards, Mortensen (1940) reexamined the two specimens and found out that one of the two specimens was collected from Sagami Bay (Japan), not Hawaii. Therefore, at the present, Japanese waters are included in the distributional range of *Caenopedina pulchella*. However, the date of collection from the Sagami Bay is not mentioned (H. L. Clark, 1912; Mortensen, 1940) and such a wide distributional range of *C. pulchella* was questioned (Mortensen 1940). Therefore, the possibility that the one specimen of *C. pulchella* collected from Sagami Bay by H. L. Clark (1912) might be a different species cannot be dismissed, and the 3 specimens collected from Japanese waters in our study are the certain records with collection date. In the future, it is necessary to examine the two individuals collected by H. L. Clark (1912) to determine if they are indeed the same species.

The results of this study indicate that three species of sea urchins of the genus *Caenopedina* have been recorded from the waters around Japan: in *Caenopedina indica*, verrucae on gonopods limited to the margins of the anal plate; shell and apical plate reddish brown, with a few bands of spines; in *C. mirabilis*, verrucae scattered on the gonopod, main spine green and 3 reddish brown to 3; *C. pulchella* with a few scattered verrucae on genital plates, central space sculptured; only 20–30 enclosing plates; apical plates dark brown, main spines light green at base, then dull brown, almost whitish distally; relatively short and stoutly built.

Based on the morphological characteristics mentioned above, we identified this specimen as *Caenopedina pulchella* because its diagnostic characteristics such as the presence of spines but no cymes and the considerable abundance of pedicellariae of all kinds were consistent with those reported by H. L. Clark (1912) and Mortensen (1940).

The specimen OMNH-IV 8458 shows the record of the northern limit and the shallowest depth range of this species.

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