Journal of Species Research 12(2):154-157, 2023

A new record of a sea star, *Henricia aspera* Fisher, 1906 (Asteroidea: Spinulosida: Echinasteridae) from Jeju Island, Korea

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A specimen of *Henricia* was collected from the adjacent waters of Moseulpo, Jeju Island, Korea, using fishing nets. The specimen was identified as *Henricia aspera* Fisher, 1906, which belongs to the family Echinasteridae of the order Spinulosida. This species can be distinguished from other *Henricia* species by its broad arms (R/r = 4.1), swollen arm base, three to seven short abactinal spines, and close-meshed formation of the actinal skeleton. This study has newly recorded *H. aspera* inhabiting the Korean fauna, bringing the total number of known *Henricia* species in Korea to 16. This study provides a description of the morphological characteristics of *H. aspera* with photographs of each part. Additionally, a table is presented that compares the morphological characteristics of *H. aspera* with closely related *Henricia* species.

Keywords: diversity, echinoderm, morphology, taxonomy

DOI:10.12651/JSR.2023.12.2.154

Introduction

Genus *Henricia* Gray, 1840 biological diversity is still underexplored, and thus only 94 species of the genus *Henricia* are documented world-wide (Mah, 2023). According to the most recent *Henricia* study in the northwest Pacific, one new species (*H. epiphysialis* Ubagan *et al*., 2020) was found in Korea, and two new deep-sea species (*H. margarethae* and *H. fragilis* Kobayashi *et al*., 2021) were discovered in Japan. Following the earlier taxonomic investigations by Clark and Jewett (2010), which led to the discovery of several previously unknown species, there was a need to explore the diversity of the genus *Henricia* in the Korean region.

On the Korean Peninsula, the diversity of *Henricia* species has been gradually increasing. Previously, Shin (2010), in her investigation, reported a total of six *Henricia* species, namely: *Henricia leviuscula* Stimpson, 1857; *Henricia nipponica* Uchida, 1928; *Henricia ohshimai* Hayashi, 1935; *Henricia pachyderma* Hayashi, 1940; *Henricia reniossa* Hayashi, 1940; and *Henricia regularis* Hayashi, 1940. Recent studies have increased the number of recorded *Henricia* species to 15 (Shin and Ubagan, 2015; Ubagan and Shin, 2016; 2019; 2020a; 2020b; 2021; Ubagan *et al*., 2020; 2023), namely: *Henricia anomala* Hayashi, 1973; *Henricia djakonovi* Chichvarkhin, 2017; *Henricia elachys* Clark & Jewett, 2010; *Henricia epiphysialis* Ubagan, Lee, Kim & Shin, 2020; *Henricia hayashii* Djakonov, 1961; *Henricia oculata* Pennant, 1777; *Henricia pacifica* Hayashi, 1940; *Henricia perforata* (O.F. Müller, 1776). However, the taxonomic understanding of the genus *Henricia* in the Korean region is far from comprehensive. Many *Henricia* species from the East Sea to the southern part of Korea are still undiscovered, and may contain unrecorded species or new to science. In this study, we provide taxonomic information for *H. aspera* based on morphological data in Korea.

Materials and Methods

An asteroid specimen was collected from the adjacent waters of Moseulpo Harbor in Jeju Island, Korea, using a fishing net on 8 September 2015. The collected specimen was preserved in 95% ethanol, and the morphological characteristics were examined, such as the size of the disk, the upper and proximal portions of the arms, the number of abactinal spines, the shape of the abactinal and actinal skeletons, and the number of adambulacral spines. The morphological features of the specimen were photographed by using a scanning electron microscope (JSM-6510; JEOL Ltd., Tokyo, Japan), stereomicroscope (Nikon

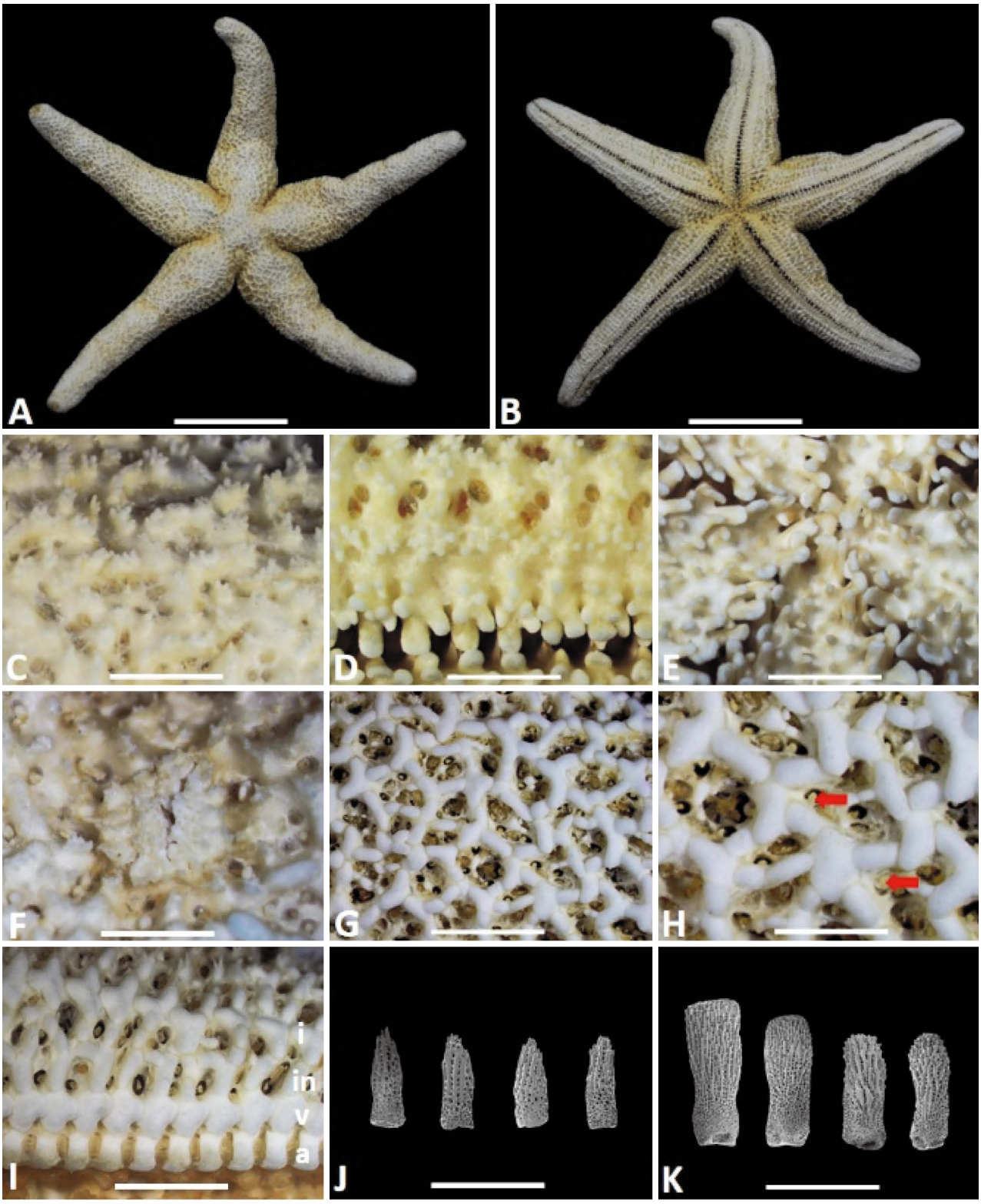

Fig. 1. *Henricia aspera*. A. abactinal side; B. actinal side; C. abactinal paxillae; D, K. adambulacral spines; E. oral part; F. madreporite; G. abactinal skeleton; H. papulae (arrows); I. actinal skeleton: inferomarginal plates (i); intermarginal plates (in), ventrolateral plates (v), adambulacral plates (a); and J. abactinal spines. Scale bars: A, B = 2 cm, C–I = 1 mm, J = 100 μm, K = 500 μm (J, K, SEM images).

Table 1. Comparison of the morphological characteristics of *H. aspera* with those of related *Henricia* species.

Characters	*H. aspera* (our specimen)	*H. pachyderma* (our specimen)
Range of R/r	4.1	4.4–4.5
Arms	slightly swollen basally, tapering to tip	broad base, tapering to tip
Number of abactinal papula(e)	2–9	1–3
Number of abactinal spines	3–7	5–13
Shape of abactinal spines	broad base to conical tip	broad base to conical tip
Shape of abactinal plates	sub-triangular, rod-like or lobed	roundish, rod-like or lobed
Number of adambulacral spines	4–8	4–6
Pattern of adambulacral furrow + near ventrolateral plate	1 short, flat tip + 2–3 stout + 4–8 shorter	1 flat tip + 2–3 slightly shorter, stout + 4–6 shorter

SMZ1000; Nikon Co., Tokyo, Japan), and a digital camera (Nikon D7000). The abbreviations for the measurements were those used by Ubagan and Shin (2020b).

Systematic Accounts

Class Asteroidea de Blainville, 1830
Order Spinulosida Perrier, 1884
Family Echinasteridae Verrill, 1870
Genus *Henricia* Gray, 1840

***Henricia aspera* Fisher, 1906**

Henricia aspera Fisher, 1906: 127; 1911: 293; Hayashi, 1940: 154; Djakonov, 1950: 87; Hayashi, 1973: 61; Mah, 2022: 369100.

Material examined. One specimen, adjacent waters of Moseulpo Harbor, 8 Sept. 2015.

Description. Arms five, long, semi-cylindrical, swollen arm base, gradually tapering to tips; disc small (Fig. 1A, B). Abactinal paxillae scattered, containing three to seven small abactinal spinelets, covered with thin integument (Fig. 1C). Denuded abactinal spines broad at base and rapidly tapering from middle part to tip (Fig. 1J). Papular areas wide with irregular shapes, containing two to nine papulae in an area; some areas bearing small ossicles (Fig. 1C, H). Denuded abactinal skeleton open meshed, reticulated, comprised of lobe-shaped and crescent-shaped plates; some skeleton forming semi-rounded plates (Fig. 1G). Madreporite sunken, situated near margin of disk, circular in form, and bearing spines similar as adjacent spines (Fig. 1F). Marginal plates well discernible. Denuded actinal skeleton showing three series of plates (Inferomarginal, intermarginal, and ventrolateral) which diverging near arm tip, leaving intermarginal plates wide spaces. Inferomarginal plates imbricated, elongated cross-shaped, reaching three-fourth length of arm. Intermarginal plate consisting of lobe-shaped plates, with small round-shape ossicles, reaching near half of arm. Ventrolateral plates rounded cross-shaped, showing larger size compared to adjacent plates; narrow papular areas with one or two papulae (Fig. 1I). Adambulacral armature composed of four to eight short, robust spinelets, inner two or three spatulate-shape, larger spines, arranged in two transverse rows or in a zigzag row (Fig. 1D). Oral plate bearing two spatulate spines (Fig. 1E). Furrow spine single.

Size. R = 70 mm, r = 17 mm, R/r = 4.1.

Habitat. Hard substrates (rocks).

Distribution. Korea (Jeju Island); Japan (Sado Island, Sagami Bay); California (Santa Barbara); Russia (Bering Island); Alaska (Pribilof Aleutian Islands).

Deposition. The collected specimen was deposited in the National Institute of Biological Resources (NIBR) in Korea.

Remarks. *Henricia aspera* shares common morphological characteristics with *Henricia pachyderma* Hayashi, 1940, by having broad arms and wide papular areas. However, four characteristics of *H. aspera* set the species apart from *H. pachyderma*, namely: the number of abactinal spines (*H. aspera*: 3–7; *H. pachyderma*: 5–13), the number of papulae on the abactinal side (*H. aspera*: 2–9; *H. pachyderma*: 1–3), smaller papular areas at the actinal side, and a compact series of elongated cross-shaped inferomarginal plates (Table 1). Our specimen has slight differences compared to the holotype description of Fisher, 1906. In terms of the basal arm shape, our specimen is slightly swollen, while Fisher's description does not have a swollen arm base and also slightly varies in the number of abactinal spines (our specimen: 3–7; Fisher's description: 5–15). In addition, the size of our specimen is smaller (R = 70 mm) compared to the original specimen (R = 100 mm). The number of abactinal spines was a distinctive characteristic of *Henricia* species, even in similar species where there was a variation in the number of spines; it was discovered to be highly reliable and stable

at identifying species (Madsen, 1987; Clark and Jewett, 2010). The *Henricia* species group, however, cannot be accurately divided based on a single characteristic. (Bratova and Paskerova, 2017). However, this slight morphological difference does not make the specimens distinct from each other. Therefore, we consider that our specimen is the same species as that described by Fisher, 1906. The collected specimen of *H. aspera* from the near waters of Moseulpo on Jeju Island is newly reported for Korean fauna.

Acknowledgements

This study was supported by a grant from the National Institute of Biological Resources, which was funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR 202203202).

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Submitted: December 28, 2022
Revised: March 17, 2023
Accepted: March 22, 2023