Korean Journal of Environmental Biology

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https://doi.org/10.11626/KJEB.2020.38.3.388

Korean J. Environ. Biol.
38(3) : 388-391 (2020)
ISSN 1226-9999 (print)
ISSN 2287-7851 (online)

New record of a sea star, *Henricia perforata* (Asteroidea: Spinulosida: Echinasteridae), in the East Sea, Korea

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Received: 9 July 2020
Revised: 25 August 2020
Revision accepted: 27 August 2020

Abstract: Sea stars were collected from the adjacent waters of Jukbyeon and Jumunjin, Korea, using fishing nets at depths of 70–100 m. The specimens were identified as *Henricia perforata* (O.F. Müller, 1776) in the family Echinasteridae and order Spinulosida, with worldwide species distribution. *H. perforata* can be distinguished from some morphologically related *Henricia* species by its long, slender, and pointed adambulacral spines. The abactinal skeleton of *H. perforata* has wide papular areas resembling those of *H. pachyderma*, but the former has more papulae (two to seven). Previously, two genera of Echinasteridae, *Aleutihenricia* and *Henricia*, with a total of 12 echinasterid species, have been reported in Korea. The morphological characteristics of *H. perforata* are described and photographs are provided.

Keywords: *Henricia perforata*, new record, taxonomy, East Sea, Korea

INTRODUCTION

The family Echinasteridae is traditionally considered to have eight genera: *Aleutihenricia* Clark and Jewett 2010; *Dictyaster* Wood-Mason and Alcock 1891; *Echinaster* Müller and Troschel 1840; *Henricia* Gray 1840; *Metrodira* Gray 1840; *Odontohenricia* Rowe and Albertson 1988; *Plectaster* Sladen 1889; *Rhopiella* Fisher 1940. The genus *Henricia* has a complex taxonomic history as many species have now been assigned to this genus (Fisher 1911; Hayashi 1940; D'yakonov 1950). Currently, the world fauna record of genus *Henricia* which include 94 valid species (Wakita *et al.* 2019), 11 of which are present in Korean fauna. However, this is considered as an underestimation of the real number of species in this diverse genus and it is likely that more species remain unidentified. Some of the previously recognized species within this genus are poorly described, and the identification of the present group of species is vague. However, several taxonomists have provided an important overview of the systematic identification and imparted a major contribution to the complex morphological variations of *Henricia* species (Clark and Downey 1992).

MATERIALS AND METHODS

The *Henricia* specimens were collected from the waters near Jukbyeon and Jumunjin, Korea, using fishing nets on May 25, 2013, and August 29, 2014, respectively. The collected specimens were 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 skeleton, and the number of adambulacral spines. The morphological features of the specimens

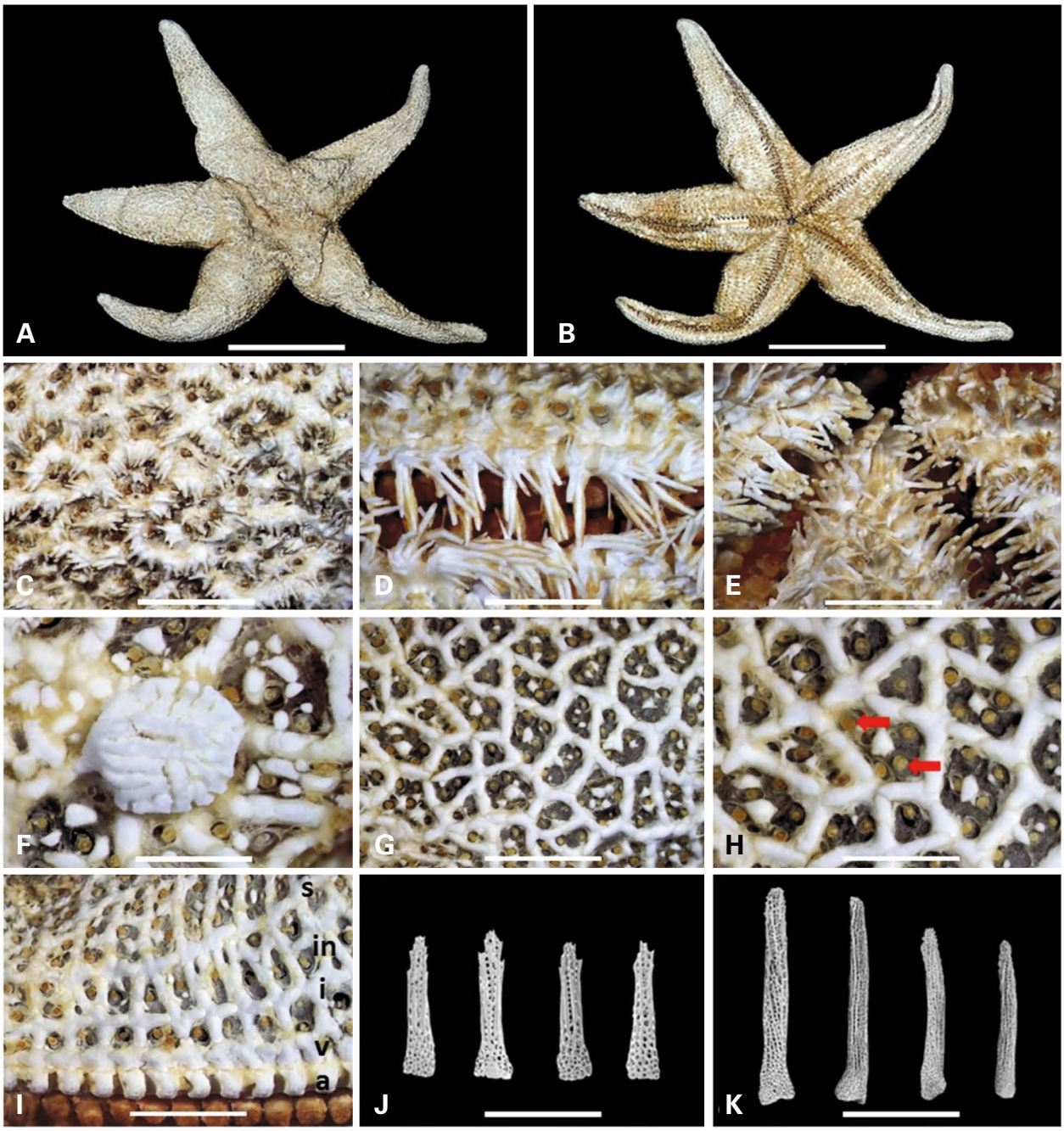

Fig. 1. *Henricia perforata*. A. abactinal side; B. actinal side; C. abactinal paxillae; D, K. adambulacral spines; E. oral part; F. madreporite; G. abactinal skeleton; H. papulae (arrows); I. actinal skeleton: superomarginal plates (s), intermarginal plates (in), inferomarginal plates (i), ventrolateral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

were photographed using a scanning electron microscope (JSM-6510; JEOL Ltd., Tokyo, Japan), stereomicroscope (Nikon SMZ1000; Nikon Co., Tokyo, Japan), and digital camera (Nikon D7000). The abbreviations for the measurements were those used by Ubagan and Shin (2019).

SYSTEMATIC ACCOUNT

Class Asteroidea de Blainville, 1830
Order Spinulosida Perrier, 1884
Family Echinasteridae Verrill, 1870

Genus *Henricia* Gray, 1840

***Henricia perforata* (O.F. Müller, 1776)**
구멍애기불가사리 (신칭) **(Fig. 1A–K)**

Henricia perforata: Madsen, 1987: pp. 243–254, figs. 3a, 31–43; Bratova and Paskerova, 2017: pp. 347–348, figs. 4a–4g; Mah, 2020: 123971.

Material examined. Two specimens, Jukbyeon, 25 May 2013, fishing net, Shin and Lee; one specimen, Jumunjin, 29 Aug. 2014, fishing net, Shin and Lee.
Description. Arms five; slightly broad arm base, gradually tapering to tips (Fig. 1A, B). Abactinal paxillae scattered, containing two to six small, delicate spinelets covered with thin integument. Wide papular areas, containing two to seven papulae in an area (Fig. 1C). Abactinal skeleton, open meshed, reticulated, composed of rod-like plates, small ossicles present within papular areas (Fig. 1H). Madreporite small, situated near center of disc, circular in form and bearing spines, same as abactinal spines (Fig. 1F). Both superomarginal and inferomarginal plates distinguishable, reaching tip of arm. Intermarginal plates contains wide spaces between inferomarginal and ventrolateral plates. Ventrolateral plates reaching three-quarters of arm length (Fig. 1I). Adambulacral armature comprising five to seven long (1.3–2.2 mm), slender spinelets, with inner spine being longer than outer spines arranged in two transverse or in zigzag rows (Fig. 1D). An oral plate bearing two slender spines (Fig. 1E). Furrow spine single.
Size. R = 54–72 mm, r = 13–16 mm, R/r = 4.1–4.5.
Habitat. Hard substrates (rocks).
Color. Body color was light brown in alcohol.
Korea. East Sea (Jukbyeon, Jumunjin).
Distribution. Korea (East Sea), NE Atlantic: Greenland Sea, North Sea (from northern British Coast, Kattegat, Skagerrak to Norwegian Coast), Norwegian Sea. NW Atlantic: Baffin Sea, Hudson Bay, Labrador Coast. Arctic: Barents Sea, Kara Sea, Laptev Sea, East Siberian Sea.
Deposition. The collected specimens have been deposited in the Marine Echinoderm Resource Bank of Korea, Sahmyook University, Seoul, Korea.
Remarks. This species has been recorded in the region of Skagerrak/Kattegat between southern Norway and Denmark and adjacent waters of Northern Atlantic (Madsen 1987; Bratova and Paskerova 2017). We compared our specimens to previously reported broad arms *H. pachyderma* in Korea and found the following differences: 1) the presence of slender to pointed tip adambulacral spines in *H. perforata* while stout shape in *H. pachyderma*; 2) by having more papulae in *H. perforata* (two to seven) compared with one to three in *H. pachyderma*; 3) the body of *H. perforata* was covered by thin skin, whereas the body *H. pachyderma* was covered by thick skin including spines. Our specimens *H. perforata* have some morphological differences compared to the North Atlantic *H. perforata*. In previous studies recorded that *H. perforata* had blunt tip adambulacral spines (Madsen 1987), but our specimens have slender to pointed tip. Furthermore, many *Henricia* species have broad geographic distributions; it is feasible that different populations might experience different environmental conditions that could result in morphological variations (Knott *et al.* 2018). Moreover, even though our specimens were found far from the region of origin (North Atlantic), we consider that Korean *H. perforata* is the same species as the Northern Atlantic *H. perforata*. This is the first report of *H. perforata* in the marine fauna of Korea.

ACKNOWLEDGEMENTS

This study was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) (NIBR201902204), and was a part of the project titled "Improvement of management strategies on marine disturbing and harmful organisms (20190518)" funded by the Ministry of Oceans and Fisheries, Korea.

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