

A New Shallow-water Species of the Genus *Odontohenricia* from Northern Japan (Asteroidea: Spinulosida: Echinasteridae)

Itaru Kobayashi^{1,2,3} and Toshihiko Fujita^{1,2}

¹ Graduate School of Science, The University of Tokyo, 7-3-1 Bunkyo-ku, Tokyo 113-0033, Japan
E-mail: i_kobayashi@kahaku.go.jp

² Department of Zoology, National Museum of Nature and Science, 4-1-1 Amakubo, Tsukuba, Ibaraki 305-0005, Japan

³ Corresponding author

(Received 17 March 2022; Accepted 13 December 2022)

<https://zoobank.org/EFEC1CB9-A010-425F-88EE-68BCA49D37A4>

A new shallow-water species of the genus *Odontohenricia* Rowe and Albertson, 1988 is described from the coast of Rishiri Island, Hokkaido, northeastern Japan. The new species is different from other congeners in having intermarginal series extending 2/3 of the arm length, abactinal spines more than 0.3 mm in length, and oral spines with opaque and serrated tips.

Key Words: echinoderm, starfish, taxonomy, Sea of Japan, Rishiri Island.

Introduction

The genus *Odontohenricia* Rowe and Albertson, 1988 is a unique member of the family Echinasteridae. It is distinguished from the other echinasterid genera in that it possesses enlarged, recurved, and unpaired tooth-like oral spine on the apex of each jaw (Clark and Jewett 2010). The function of the enlarged oral spine is not well understood. Clark and Jewett (2010) speculated that they were associated with feeding on hard prey organisms, such as sponges, coralline algae, and bryozoans. Currently, the genus includes the following eight species: *O. ahearnae* Clark and Jewett, 2010; *O. anarea* O'Hara, 1999; *O. aurantia* Clark and Jewett, 2010; *O. clarkae* Rowe and Albertson, 1988; *O. endeavouri* Rowe and Albertson, 1988; *O. fisheri* Rowe and Albertson, 1988; *O. hayashii* Rowe and Albertson, 1988; and *O. violacea* Clark and Jewett, 2010 (Rowe and Albertson 1988; O'Hara 1999; Clark and Jewett 2010). They have been predominantly reported from cold-water settings in the north and south Pacific Ocean and shown shallow to bathyal distributions (7–970 m in depth) (Rowe and Albertson 1988; Kogure and Hayashi 1998; O'Hara 1999; McKnight 2006; Clark and Jewett 2010). However, only *O. hayashii* has been recorded from these species in Japanese waters (Rowe and Albertson 1988; Kogure and Hayashi 1998).

During a survey of shallow-water starfishes in northern Japan, we found an undescribed species of the genus, *Odontohenricia*, from Rishiri Island. Herein we describe this as a new species and compare it with all the other species of the genus.

Materials and Methods

During a snorkeling survey in 2021, two living specimens were collected from the northeast coast of Rishiri Island, Japan (Fig. 1). Specimens were hand-collected from the openings between large rocks at a depth of 3 m. After relaxing the specimens in 7.4% MgCl₂ solution, they were fixed with 99.5% ethanol.

The fixed specimens were observed under a dissecting microscope (Leica MZ 8). Length of major radius (R) and minor radius (r) were measured from the center of the mouth opening to arm tips and the connection of each proximal part of two arms, respectively. Spines and epidermal tissues of the type specimens of the new species were removed from a part of the arm by applying commercial bleach (about 5% sodium hypochlorite) to observe the underlying plate arrangements. Abactinal spines at the proximal-most portion of the arms and enlarged and unpaired oral spines at the apex of jaws were collected for observation under a scanning electron microscope (SEM). The spines were immersed in a drop of commercial bleach for a few minutes and washed with deionized water to remove residual tissues. Cleaned spines were mounted on brass SEM stubs and dried in the air. Finally, the spines were coated with gold–palladium and observed under a JEOL JSM-6380LV SEM. The morphological terms follow Rowe and Albertson (1988), which established the genus *Odontohenricia*.

The holotype and a paratype of the new species examined in this study were deposited in National Museum of Nature and Science, Tsukuba (NSMT) and the Rishiri Town Museum (RTM), respectively. Additionally, we observed three specimens of *O. hayashii* from the National Museum of Nature and Science, Tsukuba (NSMT E-12592, E-13878, and

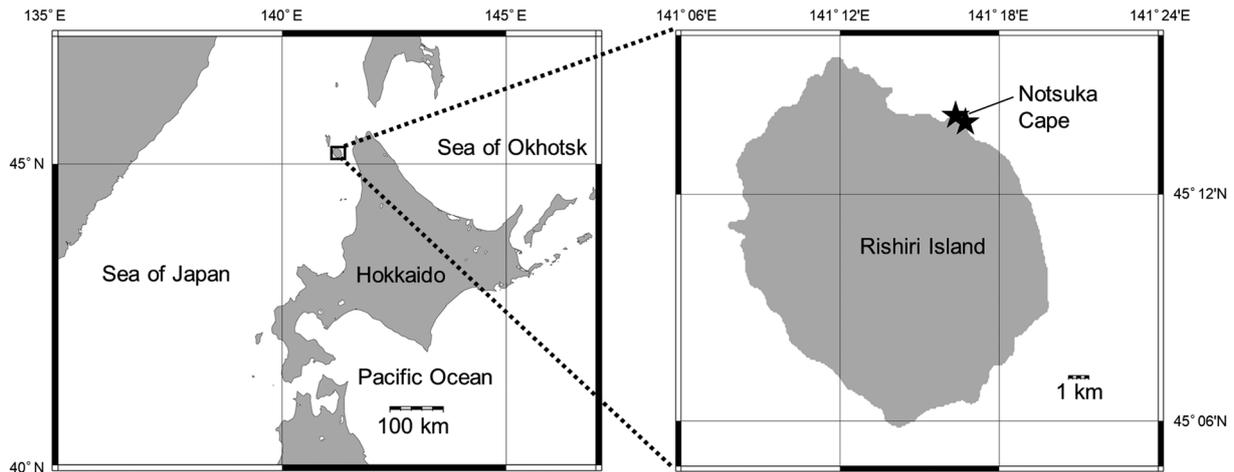


Fig. 1. Locality of sampling sites (solid stars) of *Odontohenricia occasus* n. sp.

E-13879) for morphological comparison.

Taxonomy

Family *Echinasteridae* Verrill, 1867

Genus *Odontohenricia* Rowe and Albertson, 1988

[New Japanese name: Nise-hime-hitode-zoku]

Odontohenricia occasus n. sp.

[New Japanese name: Yuyake-nise-hime-hitode]

(Figs 2, 3A, B)

Material examined. Holotype. NSMT E-13876, Notsuka Cape, Rishiri Island, Hokkaido, Japan (45°14.0832'N, 141°16.3560'E), 3 m in depth, on 30 August 2021, fixed in 99.5% ethanol. One paratype. RTMECH4, Notsuka Cape, Rishiri Island, Hokkaido, Japan (45°13.9059'N, 141°16.7259'E), 3 m in depth, on 30 August 2021, fixed in 99.5% ethanol.

Diagnosis. Arms five. The abactinal skeleton is an irregular, open meshwork. Papular areas are larger than abactinal plates, containing 1 or 2 papulae. Abactinal spines are serrated at the tip. Abactinal spines, 1–10 gathered in a tuft-like pseudopaxilla that is widely separated from each other. Supero- and inferomarginal series are discernible. The intermarginal series extends to two-thirds of the arm length. Each adambulacral plate bears 6–14 subambulacral spines and 1 furrow spine. Each enlarged and unpaired oral spine has an opaque and serrated tip.

Description of holotype. Arms five, subcylindrical in shape, slender, and gradually tapering to the arm tip (Fig. 2A). R is 34.1 mm, r is 6.3 mm, and R/r ratio is 5.5r. The abactinal skeleton is an irregular open meshwork, constituted by many oval to rod-shaped, trilobate, and quadrilobate abactinal plates (Fig. 2B). Abactinal plates are partially imbricated with each other. Each abactinal papular area is larger than the surrounding plates, containing 1 or 2 papulae and often 1 secondary abactinal plate (Fig. 2B, C). Each abactinal plate bears 1–10 abactinal spines gathered in a tuft (Fig. 2C). Abactinal spines are arranged irregularly and

grouped to form pseudopaxillae. Each pseudopaxilla is separated from its neighbors by relatively sunken papular areas or bared spaces and does not touch with other pseudopaxillae. A madreporite is located at the margin of the disk with several spines on its surface.

Abactinal spines are 0.39–0.45 mm in length. The spines are straight, cylindrical, and uniformly smooth, except for the tip with serration by splayed thorns (Fig. 3A).

Superomarginal plates are large quadrilobate or small rod-shaped and arranged in longitudinal series (Fig. 2D). These two forms are alternately arranged at the proximal half of the arms, and only large quadrilobate plates are continuously arranged at the distal half of the arms. Inferomarginal plates are quadrilobate and are arranged in longitudinal series. Supero- and inferomarginal plates are gradually decreasing in size toward the arm tips. Each quadrilobate superomarginal plate bears 9–11 spines, and each small rod-shaped superomarginal plate bears 1–4 spines. Each inferomarginal plate bears 10–19 spines. The supero- and inferomarginal spines are irregularly arranged in 2 irregular transverse rows (Fig. 2E). Beginning proximally, marginal series are separated from one another by up to two-thirds of the arm length. The superomarginal series gradually comes in contact with the inferomarginal series toward the arm tips (Fig. 2D). Intermarginal plates present, rod or quadrilobate in shape. These plates arranged irregularly at the proximal part of the arm but arranged in longitudinal series beyond the proximal one-third of the arm length. Papulae present along the marginal series (Fig. 2E).

Actinal plates are quadrilobate and arranged in 2 longitudinal series (Fig. 2D, E). The first series extends proximal half to two-thirds of the arm length. The second series is confined within one-third of the arm length. Each actinal plate bears 2–12 spines in 2 or 3 irregular rows (Fig. 2E). Papulae present between the inferomarginal and first actinal series, and the inferomarginal and second actinal series, but absent between the first and second actinal series, and the first actinal and adambulacral series.

Most adambulacral plates bear 1 furrow spines deep in the furrow and 6–14 subambulacral spines (Fig. 2E, F). Fur-

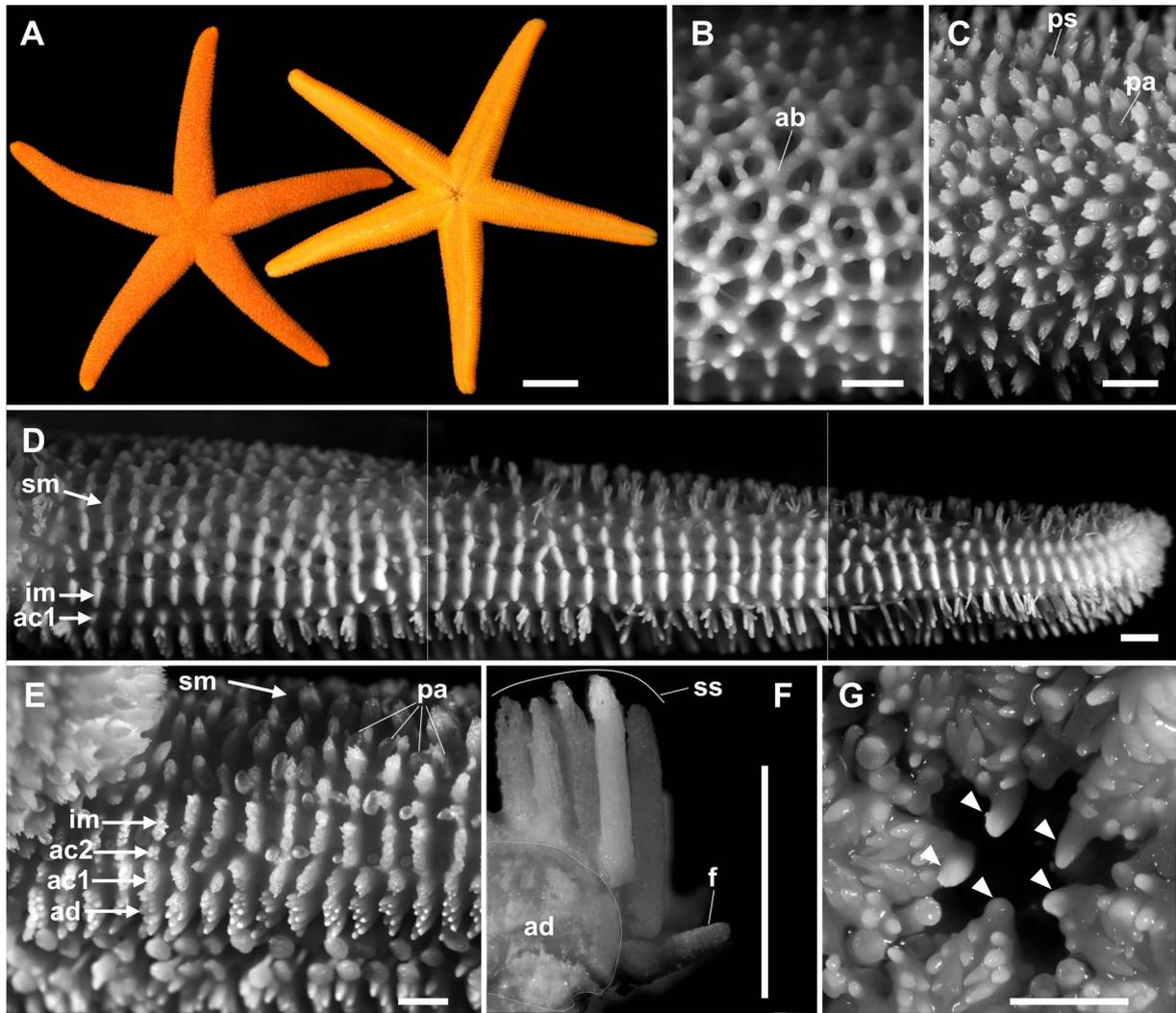


Fig. 2. *Odontohenricia occasus* n. sp., holotype, NSMT E-13876. A, Live specimen, abactinal (left) and actinal (right) views; B, denuded abactinal surface of the proximal portion of the arm; C, abactinal surface of the proximal portion of the arm; D, denuded lateral to actinal surface of the whole arm length; E, lateral to actinal surface at the proximal portion of the arm; F, distal view of 9th adambulacral plate, 8th and 9th adambulacral plates were excised from the arm; G, oral region, showing unpaired and enlarged oral spines (arrow heads). Abbreviations: ab, abactinal plates; ac1, first actinal series; ac2, second actinal series; ad, adambulacral series; f, furrow spine; im, inferomarginal series; pa, papulae; ps, pseudopaxillae; sm, superomarginal series; ss, subambulacral spines. Scale bars indicate 10 mm for A, 1 mm for B–G. Proximal is left in B–E.

row spines and the adradial most subambulacral spine are arranged in a vertical row on the adradial surface of the adambulacral plate, and the remaining subambulacral spines are arranged in 2 or rarely 3 irregular transverse rows on the actinal surface of the adambulacral plate.

Each pair of oral plates, which forms a jaw, bears 1 large recurved and unpaired oral spine on its proximal edge (Fig. 2G). About proximal half or more of the spines are uniformly smooth without lateral serration, and the distal half or less of the spines is serrated with thorny projections (Fig. 3B). Each oral spine has numerous perforations on the overall length and lacks hyaline area.

The color in life is uniform reddish yellow on the abactinal side and more vivid yellow on the actinal side (Fig. 2A).

Variations in paratype. R is 35.5 mm, r is 6.3 mm, and R/r ratio is 5.6r. Superomarginal plates are more inconspicuous than the holotype, and the superomarginal plates in the

arm base do not show any signs of regular series. Each inferomarginal, actinal, and adambulacral plate bears 9–17, 4–14, and 6–12 spines, respectively.

Distribution. *Odontohenricia occasus* n. sp. is only known from the type locality, Notsuka Cape, Rishiri Island, Hokkaido, 3 m in depth.

Etymology. The specific name “*occasus*” is a noun in apposition derived from the Latin word “*occasus*”, meaning “sunset”. The species depicts beautiful reddish yellow like sunset colors. The Japanese name “yuyake” also means sunset in Japanese, and “nise-hime-hitode” comes from the Japanese name of the congeneric species, *O. hayashii* (Kogure 2018). Therefore, the latter name is also designated for the Japanese name of the genus in this study.

Remarks. Among the species of *Odontohenricia*, three species, *O. ahearnae*, *O. clarkae*, and *O. endeavouri* share the long intermarginal series extending two-thirds of the

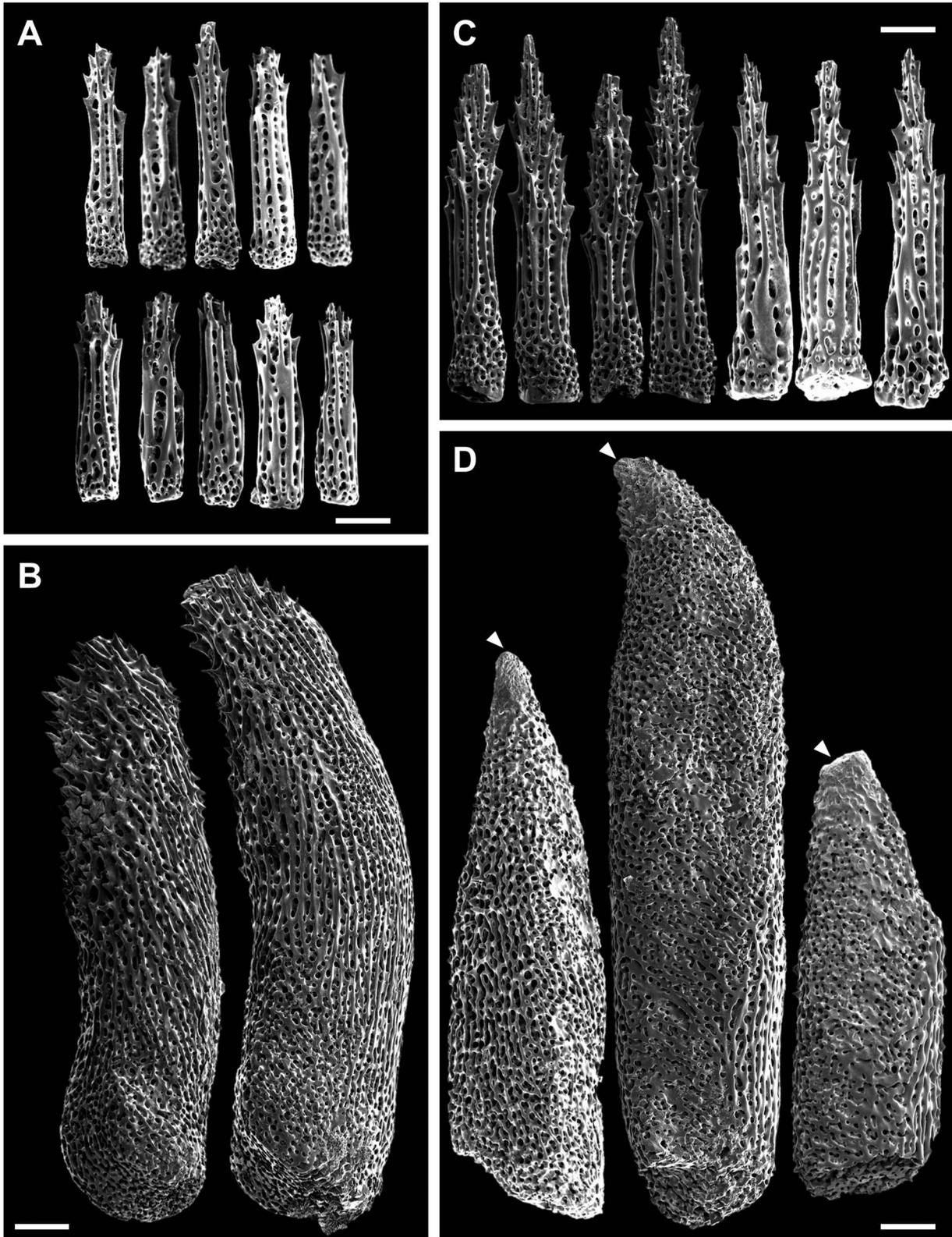


Fig. 3. SEM images of spines of *Odontohehricia occasus* n. sp. and *Odontohehricia hayashii*. A, Abactinal spines of *O. occasus* n. sp., holotype, NSMT E-13876 (above), paratype, RTMECH4 (below); B, unpaired and enlarged oral spines of *O. occasus* n. sp., holotype, NSMT E-13876 (left), paratype, RTMECH4 (right); C, abactinal spines of *O. hayashii*, NSMT E-12592 (left four), NSMT E-13879 (right three); D, unpaired and enlarged oral spines of *O. hayashii*, NSMT E-13878 (left), NSMT E-12592 (center), and NSMT E-13879 (right, tip is partially broken), showing the hyaline area at the tip (arrow heads). Scale bar indicates 0.1 mm in all images. Distal side is left in B and D.

arm length (Rowe and Albertson 1988; O'Hara 1999; Clark and Jewett 2010) with *O. occasus* n. sp. However, the abactinal spines of the new species are 0.39–0.45 mm in length, while those of three congeners are 0.26 mm or less (Rowe and Albertson 1988; Clark and Jewett 2010). Moreover, the morphology of the enlarged oral spines is different between the new species and the three species. *O. occasus* n. sp. has a serrated and opaque tip (Fig. 3B), whereas those of the three species have smooth or hyaline tip (Rowe and Albertson 1988; Clark and Jewett 2010). The apically smooth and hyaline oral spines are also known from *O. fisheri* and *O. hayashii* (Rowe and Albertson 1988; see Fig. 3D). Additionally, we found a clear difference in the shape of abactinal spines observing three similarly sized NSMT specimens of Japanese species, *O. hayashii* (E-12592 from Tosa Bay, R = 40.1 mm, r = 6.0 mm; E-13878 from the Sea of Japan, R = 38.8 mm, r = 5.8 mm; E-13879 from the Sea of Japan, R = 35.1 mm, r = 5.1 mm). Each abactinal spine of holotype and paratype of *O. occasus* n. sp. has a large smooth surface without the lateral serration, which occupy more than basal two-thirds of the spines (Fig. 3A). In contrast, each abactinal spines of *O. hayashii* has a smaller smooth surface, which is limited to the basal half of the spines (Fig. 3C).

The genus *Odontohenricia* shows close morphological affinities with the confamilial genus *Henricia* Gray, 1840 except for the presence of enlarged and unpaired oral spines (Rowe and Albertson 1988; O'Hara 1999). Of Japanese *Henricia* species, only *H. pacifica* Hayashi, 1940 has the long intermarginal series which extends two-thirds of the arm length, 10 or less abactinal spines, and 1 furrow spine and 10–15 subambulacral spines on each adambulacral plate like *O. occasus* n. sp. (Hayashi 1940). However, the abactinal spines of *H. pacifica* are conical, not serrated, and sharply pointed (Xiao et al. 2011), unlike those of the new species (Fig. 3A).

Key to the Species of the Genus *Odontohenricia*

A key is provided based on our observations and previous descriptive papers (Rowe and Albertson 1988; O'Hara 1999; Clark and Jewett 2010). The range of R for each species is based on all measurements of *Odontohenricia* specimens (Rowe and Albertson 1988; O'Hara 1999; McKnight 2006; Clark and Jewett 2010; this study). In each key, morphological characters are applied fully for the size range mentioned.

1. Intermarginal series are short, half or less of the arm length; R = 25–210 mm. 2
 - Intermarginal series are long, more than half of the arm length; R = 26–120 mm. 6
2. Papular areas contain 2 or less papulae; each adambulacral plate bears more than 20 subambulacral spines; R is up to 210 mm 3
 - Papular areas usually contain 3 or more papulae; each adambulacral plate bears less than 20 subambulacral spines; R = 25–82 mm 4
3. Abactinal color in life is orange; each oral plate bears 16–31 marginal and suboral spines; R is up to 170 mm

- *O. aurantia*
- Abactinal color in life is violet; each oral plate bears 13–16 marginal and suboral spines; R is up to 210 mm *O. violacea*
- 4. Each abactinal plate bears 15–20 abactinal spines; each adambulacral plate bears 12–16 subambulacral spines; R = 82 mm. *O. fisheri*
 - Each abactinal plate bears 9 or less abactinal spines; each adambulacral plate bears 11 or less subambulacral spines; R = 25–58 mm 5
- 5. Japan; R = 35–40 mm *O. hayashii*
 - Macquarie Island, Australia; R = 25–58 mm *O. anarea*
- 6. Abactinal spines are more than 0.3 mm in length; enlarged oral spines have serrated and opaque tip; R = 34–36 mm *O. occasus* n. sp.
 - Abactinal spines are less than 0.3 mm in length; enlarged oral spines do not have serrated and opaque tip; R = 26–120 mm 7
- 7. Each abactinal plate bears 25–50 abactinal spines; each adambulacral plate bears 17–25 subambulacral spines; R is up to 120 mm *O. ahearnae*
 - Each abactinal plate bears 15 or less abactinal spines; each adambulacral plate bears 14 or less subambulacral spines; R = 26–86 mm 8
- 8. Papular areas contain 2–9 papulae; each adambulacral plate bears 1–2 furrow spines; R = 26–33 mm.
 - *O. clarkae*
 - Papular areas contain 1–3 papulae; each adambulacral plate bears 2–3 furrow spines; R = 31–86 mm.
 - *O. endeavouri*

Acknowledgments

We would like to express our sincere gratitude to Drs. Masahiko Sato and Shinri Tomioka (RTM) and the staff of the Rishiri-Umineko guest house for their kind support in the fieldwork. We also thank to Dr. Yasuo Kano for providing specimens of *O. hayashii* (E-13878 and E-13879). We thank two anonymous reviewers for the constructive and valuable comments. The authors would like to thank Enago (www.enago.jp) for the English language review. This study was supported by the Rishiri Research Project (in FY2020), and partly by JSPS KAKENHI Grant Number 21K06327.

References

Clark, R. N. and Jewett, S. C. 2010. A new genus and thirteen new species of sea stars (Asteroidea: Echinasteridae) from the Aleutian Island Archipelago. *Zootaxa* 2571: 1–36.

Hayashi, R. 1940. Contributions to the classification of the sea-stars of Japan. I. Spinulosa. *Journal of the Faculty of Science, Hokkaido Imperial University Series 6, Zoology* 7: 107–204.

Kogure, Y. 2018. A checklist of sea stars (Echinodermata, Asteroidea) from Japanese waters. *Bulletin of the Biogeographical Society of Japan* 73: 70–86.

Kogure, Y. and Hayashi, I. 1998. Bathymetric distribution pattern

- of echinoderms in the Sado Strait, the Japan sea. Bulletin of the Japan Sea National Fisheries Research Institute 48: 1–16.
- McKnight, D. G. 2006. The marine fauna of New Zealand Echinodermata: Asteroidea (Sea-stars). 3. Orders Velatida, Spinulosida, Forcipulatida, Brisingida with addenda to Paxillosida, Valvatida. NIWA Biodiversity Memoir 120: 1–187.
- O'Hara, T. D. 1999. Systematics and biology of Macquarie Island echinoderms. Memoirs of Museum Victoria 57: 167–223.
- Rowe, F. W. E. and Albertson, E. L. 1988. A new genus and four new species in the family Echinasteridae (Echinodermata: Asteroidea). Proceedings of the Linnean Society of New South Wales 110: 83–100.
- Verrill, A. E. 1867. Notes on Radiata in the Museum of Yale College, with descriptions of new genera and species. No. 3. On the geographical distribution of the echinoderms of the west coast of America. Transactions of the Connecticut Academy of Arts and Science 1: 323–351.
- Xiao, N., Liao, Y., and Liu, R. 2011. Records of the genus *Henricia* Gray, 1840 (Echinodermata: Asteroidea: Echinasteridae) from Chinese waters. Zootaxa 3115: 1–20.