Zoosymposia 15: 123–128 (2019)
http://www.mapress.com/j/zs/

ISSN 1178-9905 (print edition)
ZOOSYMPOSIA
ISSN 1178-9913 (online edition)

http://dx.doi.org/10.11646/zoosymposia.15.1.14
http://zoobank.org/urn:lsid:zoobank.org:pub:F3032972-1207-4432-9AB7-8268432CD715

The echinoid fauna from middle and southern Japan: a preliminary report

MASAYA SAITOH[1*], ANDREAS KROH[2], OMRI BRONSTEIN[2], SHU NAKACHI[3], MASAMI OBUCHI[4], YUKI KIYONO[5] & KEN'ICHI KANAZAWA[6]

[1] *Research Institute for Integrated Science, Kanagawa University, Hiratsuka City, Kanagawa 259-1293, Japan*
[2] *Department of Geology & Palaeontology, Natural History Museum Vienna, 1010 Vienna, Austria*
[3] *Biological Institute on Kuroshio, Kuroshio Biological Research Foundation, Otsuki town, Kochi 788-0333, Japan*
[4] *Education Center, Manazuru Town Office, Manazuru Town, Kanagawa 259-0202, Japan*
[5] *Department of Biological Sciences, Graduate School of Science, Kanagawa University, Hiratsuka City, Kanagawa 259-1293, Japan*
[6] *Department of Biological Sciences, Faculty of Science, Kanagawa University, Hiratsuka City, Kanagawa 259-1293, Japan*
**saitangoid@gmail.com*

Abstract

Fifty-eight echinoid species from 22 families in nine orders were collected from middle and southern Japan. One species, *Aeropsis fulva*, is reported here for the first time from Japan, and four species, *Mespilia levituberculata*, *Pseudoboletia maculata*, *Lissodiadema purpureum* and *Echinodiscus tenuissimus* require systematic re-examination.

Introduction

In 2017 we launched a project aimed at summarizing the West Pacific echinoid fauna. As the first step, we have been reviewing the ecology and phylogeny of extant Japanese echinoids documented in the literature, supplemented by novel data obtained by fieldwork. These data are intended as a baseline for our future research on the echinoids living in greater West Pacific region.

Utinomi (1954, 1960) and Shigei (1981, 1986) summarized extant echinoid occurrences from the sea around Japan, and to date 112 echinoid species have been reported (Shigei 1986). However, in their works, ecological information of the species was scant or missing, especially concerning habitat information. Since these early studies, no comprehensive study of Japanese echinoids has been published. In the current project, sea urchins were collected from their natural habitats primarily by scuba diving and detailed ecological information was recorded. Apart from a thorough morphological taxonomic evaluation, freshly collected specimens are also subjected to molecular genetic analyses to validate their phylogenetic relationships. Here, we give a preliminary report of our fieldwork in middle and southern Japan in 2017 and 2018, during which we were able to observe and sample 58 different echinoid species accounting for more than half of currently described Japanese echinoids.

Sampling

Sampling was carried out in the following localities in middle to southern Japan (Fig. 1): by hand in the intertidal zone of Shirahama Beach (35°09′14 N, 139°08′41 E), Sesoko Island (26°38′04″ N, 127°51′53″ E) and Ginama (26°50′19″ N, 128°15′00″ E) and from drifting seaweeds in Owase Bay (34°04′22″ N, 136°12′58″ E); by scuba-diving in Aburatsubo (35°09′26″ N, 139°36′40″ E) (Misaki Marine Biological Station), Toi (34°54′24″ N, 138°47′07″ E), Takugi (36°09′49″ N, 133°15'24″ E), Komame (32°47′29″ N, 132°41′42″ E), Tachibanaura (32°49′57″ N, 132°39′44″ E), Kasiwa Island (32°46′31″ N, 132°38′07″ E), Issai (32°47′11″ N, 132°38′04″ E), Nishidomarisurugi-no-Hama (32°46′39″ N, 132°43′55″ E), Oura Bay (26°32′30″ N, 128°03′15″ E), Mizugama (26°21′36″ N, 127°44′18″ E), and Manzamo (26°30′15″ N, 127°50′38″ E); by

Accepted by Y. Agatsuma: 5 Jan. 2019; published: 21 Oct. 2019

dredging in Sagami Bay using by aboard the vessel R/V Rinkai-maru of the Misaki Marine Biological Station, off Tosashimizu and in Kumanonada by aboard the vessel R/V Seisui-maru of Mie University.

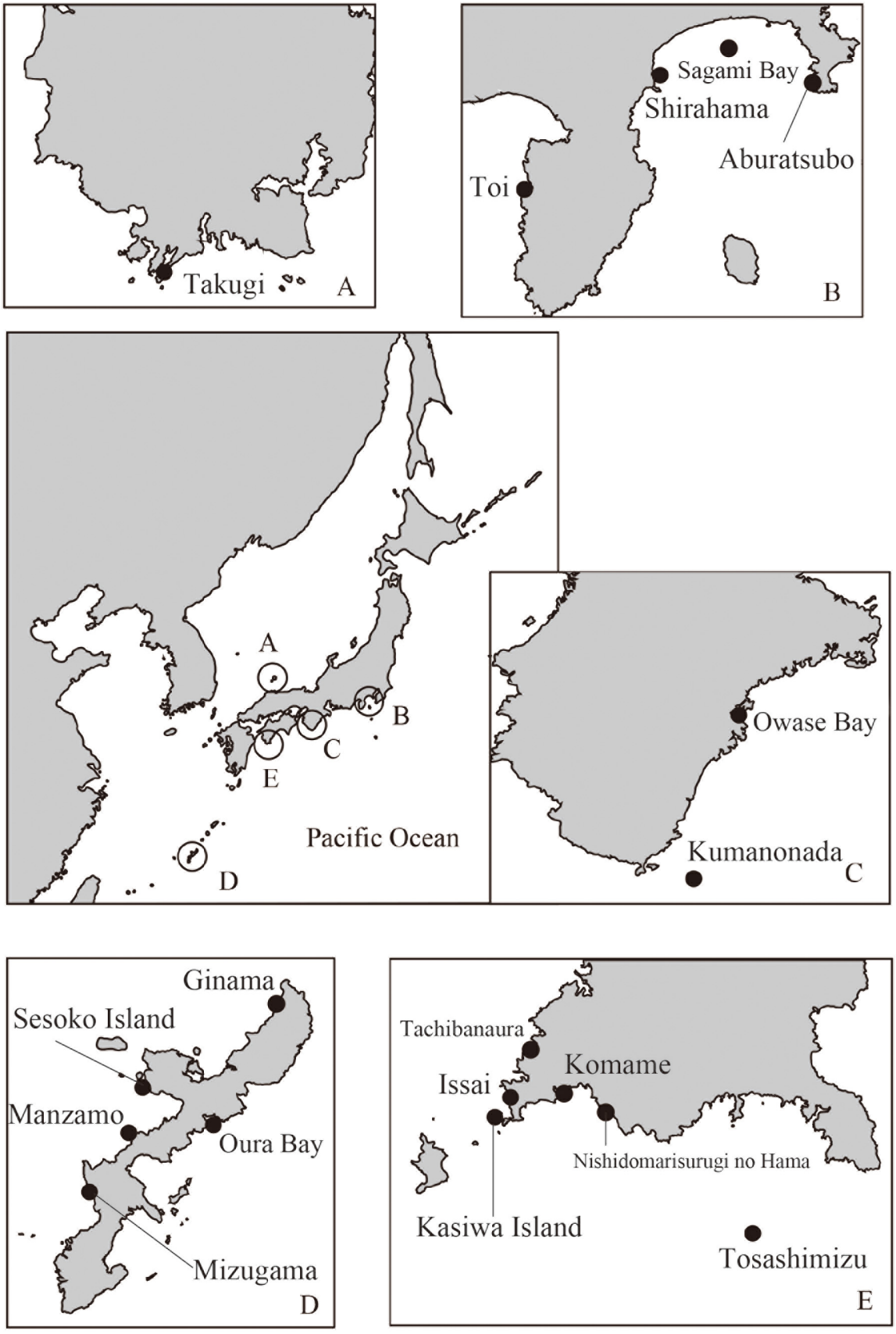

FIGURE 1. Map of sampling localities.

Sea urchins collected in this study

The fifty-eight species from 22 families of nine orders collected during our investigations are summarized in Table 1. *Aeropsis fulva* was recorded for the first time from Japan; a brief discussion on the new record is given below. Four species, *Mespilia levituberculata*, *Pseudoboletia maculata*, *Lissodiadema purpureum*, and *Sculpstechinus tenuissimus* require systematic re-examination. Brief comments for these species are given below.

TABLE 1. List of echinoid species collected from middle and southern Japan.

Order	Family	*Species*	Locality	Water Depth (m)
Cidaroida	Cidaridae	*Acanthocidaris maculicolis*	Tosashimizu	115
		Eucidaris metularia	Kasiwa Island	10
		Goniocidaris biserialis	Tosashimizu	120
		Phyllacanthus sp.	Mizugama	5
		Plococidaris verticillata	Nishidomarisurugi-no-Hama	5–7
		Prionocidaris baculosa	Kasiwa Island	10–20
		Rhopalocidaris gracilis	Tosashimizu	120
		Stylocidaris bracteata	Tosashimizu	115
		Chorocidaris fusispina	Tosashimizu	110
		Stylocidaris reini	Tosashimizu	120–150
Echinothurioida	Echinothuriidae	*Araeosoma owstoni*	Kumanonada	740
		Asthenosoma ijimai	Issai	40
		Calveriosoma gracile	Kumanonada	450
	Phormosomatidae	*Phormosoma bursarium*	Kumanonada	557
Diadematoida	Diadematidae	*Diadema clarki*	Kasiwa Island	10
		Diadema setosum	Tachibanaura	6
		Echinothrix calamaris	Komame	8
		Lissodiadema purpureum	Mizugama	3–8
Stomopneustoida	Stomopneustidae	*Stomopneustes variolaris*	Kasiwa Island	10
Pedinoida	Pedinidae	*Caenopedina mirabilis*	Kumanonada	218
Camarodonta	Echinidae	*Gracilechinus lucidus*	Kumanonada	217–557
	Temnopleuridae	*Mespilia levituberculata*	Aburatsubo	5
		Microcyphus excentricus	Mizugama	3–8
		Temnopleurus toreumaticus	Owase Bay	1
	Toxopneustidae	*Pseudoboletia maculata*	Tachibanaura	8
		Toxopneustes elegans	Tachibanaura	8
		Toxopneustes pileolus	Komame	8
		Tripneustes gratilla	Komame	8
	Strongylocentrotidae	*Pseudocentrotus depressus*	Shirahama-beach	Intertidal zone
		Hemicentrotus pulcherrimus	Shirahama-beach	Intertidal zone
	Echinometridae	*Colobocentrotus mertensii*	Ginama	Intertidal zone
		Echinometra mathaei	Tachibanaura	5
		Echinometra oblonga	Sesoko Island	Intertidal zone
		Echinometra sp. A	Komame	5
		Echinometra sp. C	Sesoko Island	Intertidal zone
		Echinostrephus aciculatus	Tachibanaura	5
		Echinostrephus molaris	Mizugama	3–7
		Heliocidaris crassispina	Shirahama-beach	Intertidal zone
		Heterocentrotus mamillatus	Mizugama	2

...Continued on next page

TABLE 1. (Continued)

Order	Family	*Species*	Locality	Water Depth (m)
Clypeasteroida	Clypeasteridae	*Clypeaster japonicus*	Toi	10
		Clypeaster virescens	Tosashimizu	120
	Laganidae	*Laganum fudsiyama*	Kumanonada	190
		Peronella japonica	Aburatsubo	7
	Scutellidae	*Scaphechinus mirabilis*	Sagami Bay	3
	Astriclypeidae	*Astriclypeus mannii*	Aburatsubo	7
		Sculpsitechinus sp.	Oura Bay	10
Holasteroida	Pourtalesiidae	*Pourtalesia laguncula*	Kumanonada	557
Spatangoida	Schizasteridae	*Moira lachesinella*	Takugi	10
	Aeropsidae	*Aeropsis fulva*	Kumanonada	834
	Brissidae	*Brissopsis luzonica*	Kumanonada	834
		Brissus agassizii	Takugi	10
		Metalia sp.	Takugi	9
	Eurypatagidae	*Linopneustes murrayi*	Kumanonada	740–834
		Platybrissus roemeri	Mizugama	8
	Maretiidae	*Maretia planulata*	Oura Bay	10
		Nacospatangus altus	Takugi	5–18
	Loveniidae	*Lovenia elongata*	Takugi	5–9
		Lovenia gregalis	*Kumanonada*	740

Aeropsis fulva (A. Agassiz, 1898)
1898 *Aërope fulva* A. Ag.—Agassiz: 81; pl. 8: figs 5–6.
1950 *Aëropsis fulva* (A. Agassiz).—Mortensen: 329.

Remarks: The highly modified test with a peculiar spindle-shaped form and position of the periproct above the ambitus make members of the genus *Aeropsis* immediately recognizable. Currently (Kroh & Mooi 2018) two species of the genus have been described, which can usually be distinguished based on their number of gonopores, being two in the Atlantic species *A. rostrata* (Norman, 1876) (see e.g. Mortensen 1907: fig. 15 or Kroh 2004: fig. 2/3d) and four in the Pacific *A. fulva* (see Agassiz 1904: figs. 281, 282). Although specimens with two gonopores have been reported in *A. fulva* too (e.g. Agassiz 1904: fig. 283), none with four pores are known in *A. rostrata*. Combined with the anterior position of the highest point of the test and the low test height (compare the key in Mortensen 1950: p. 327) the new Japanese specimen, which shows four gonopores thus can be confidently placed in *A. fulva*.

This species was initially described from the East Pacific, having been caught at several stations in the region south of Panama during the Albatross Cruise (Agassiz 1898: p. 81). Its range was later extended to deep waters off the coasts of Peru, the Bering Sea and Arafura Sea (see Mortensen 1950). Specimens from deep water off the coasts of California, Oregon and Washington State are recorded in collection of the California Academy of Sciences (https://www.gbif.org/species/5188153). The new occurrence in Japan is consistent with those earlier reports and suggests a wide distribution throughout the Pacific Ocean. The lack of records from large parts of this area might be explained by the depth inhabited by this species and its fragile test, both of which hamper collection.
Occurrence in Japan: Kumanonada, at a depth of 834 m.

Mespilia levituberculata Yoshiwara, 1898
Remarks: All echinoids of the genus *Mespilia* living around Japan have been attributed to *Mespilia globulus* since Shigei (1986) summarized Japanese echinoids, though he noted that Japanese specimens are morphologically very different from the specimens from other Indo-West-Pacific regions. Japanese *Mespilia* have originally been described as *M. levituberculata* by Yoshiwara (1898). However, this species has been synonymized with *M. globulus* by Clark (1912). Mortensen (1943), in contrast, suggested to "maintain the

Japanese form *Mespilia levituberculata* Yoshiwara to be, at least, a well characterized variety, if not rather a distinct species" and stated that "var. *levituberculata* is known only from Japan, from Sagami Bay to Kiushu". Specimens of *Mesipilia* collected in this study were provisionally identified as *M. levituberculata* due to their striking morphological difference to *Mesipilia globulosa* from e.g., the Philippines. In-depth examinations of the phylogenetic relationship of the two forms are currently under way.

Pseudoboletia maculata Troschel, 1869
Remarks: Shigei (1986) described only one species from the genus *Pseudoboletia*, i.e. *P. indiana*, from Japan. *Pseudoboletia* specimens collected during the present study were identified as *P. maculata* based on their test bearing conspicuous dark spots. Utinomi (1954) was the first to report *Pseudoboletia maculata* from Japan and coined the Japanese name, "Madara-Uni" for this species. Shigei (1981) also reported that *Pseudoboletia* species collected around Japan as *P. maculata*. In Shigei's (1986) faunal list of Japanese echinoids, however, *Pseudoboletia maculata* was missing, and instead *P. indiana* was included, associated with the Japanese name "Madara-Uni". He noted that the specimens having a denuded test with whitish color should be attributed to *P. indiana*. A phylogenetic study to confirm the morphological identification of these specimens is currently in progress.

Lissodiadema purpureum (A. Agassiz & H.L. Clark, 1907)
Remarks: We collected the specimens from the same locality where Obuchi *et al.* (2013) reported the occurrence of *Lissodiadema lorioli*. Based on morphological observations, however, the newly collected material fits better with *L. purpureum* than *L. lorioli*. *L. purpureum* was originally described as *Leptodiadema purpureum* based on a single juvenile specimen from Hawaii. However, the genus *Leptodiadema* has since been synonymized with *Lissodiadema* (Schultz in Smith & Kroh, 2007) based on the examination of adult specimens found in Guam. A comprehensive description of this species, however, is still missing. We are currently working on a detailed re-description of the species including a molecular genetic analysis.

Sculpstechinus tenuissimus (L. Agassiz & Desor, 1847)
Remarks: This sand dollars with two lunules in the posterior ambulacra occurs around Okinawa. It was first recorded by Shigei (1986) under the name *Echinodiscus tenuissimus*. Stara & Sanciu (2014) have recently revised the classification of fossil and recent astriclypeid echinoids and have established several new genera in this family. The Japanese specimens show features supporting the attribution to the genus *Sculpsitechinus*; however, the neotype of *S. tenuissimus* from New Caledonia, designated by Stara & Sanciu (2014) is very different from Japanese *Sculpsitechinus* specimens and the conspecificity of the two populations needs to be re-evaluated and thoroughly explored.

Gracilechinus lucidus (Döderlein, 1885)
Remarks: Shigei (1986) included *Echinus lucidus* in the Japanese echinoid list. Currently this taxon is known as *Gracilechinus lucidus* (see Kroh & Mooi, 2018).

Acknowledgments

The authors are grateful to Kazuto Abe (Okinokuni Diving), Yuki Abe (Okinokuni Diving), Kadzuho Yamamoto (The 101), the staff of the Misaki Marine Biological Station and the crew of the R/V Seisui-maru of Mie University for their kind guidance and help during the field investigations. Professor Thomas A. Ebert (Oregon State University) and anonymous reviewer provided many helpful comments which improved our manuscript. This study was supported by a research grant for collaborative projects of Kanagawa University. Research of AK and OB is funded by the Austrian Science Fund (FWF): project P-29508-B25.

References

Agassiz, A. (1898) Reports on the dredging operations off the west coast of Central America to the Galįpagos, to the the west coast of México, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U.S. Fish Commission

Streamer “Albatross”, during 1891, Lieut. Commander Z. L. Tanner, U.S.N., Commanding. XXIII. Preliminary report on the Echini. *Bulletin of the Museum of Comparative Zoölogy*, 32, 71–86.

Agassiz, A. (1904) The Panamic Deep Sea Echini. *Memoirs of the Museum of Comparative Zoölogy at Harvard College*, 31, ix+1–243.

Agassiz, A. & Clark, H.L. (1907) Preliminary report on the echini collected, in 1902, among the Hawaiian Islands, by the U.S. Fish Commission steamer “Albatross”, in charge of Commander Chauncey Thomas, U.S.N., commanding. *Bulletin of the Museum of Comparative Zoölogy at Harvard College*, 50 (8), 231–259.

Agassiz, L. & Desor, P.J.E. (1847) Catalogue raisonné des espèces, des genres, et des familles d’échinides. *Annales des Sciences Naturelles, Troisième Série, Zoologie*, 7, 129–168.

Clark, H.L. (1912) Hawaiian and other Pacific Echini. The Pedinidae, Phymosomatidae, Stomopneustidae, and Echinometridae. *Memoirs of the Museum of Comparative Zoology at Harvard College*, 34, 205–383. https://doi.org/10.5962/bhl.title.3820

Döderlein, L. (1885) Seeigel von Japan und den Liu-Kiu Inseln. *Archiv für Naturgeschichte*, 51 (1), 73–112. https://doi.org/10.5962/bhl.part.1569

Kroh, A. (2004) *Cottreaucorys kollmanni* n. sp. (Echinodermata: Echinoidea) and other new records from the Early Paleocene Bruderndorf Formation in Austria. *Annalen des Naturhistorischen Museums in Wien, Serie A*, 106, 309–325.

Kroh, A. & Mooi, R. (2018) World Echinoidea Database. Available from: http://www.marinespecies.org/echinoidea (accessed 6 December 2013)

Mortensen, T. (1907) *The Danish Ingolf-Expedition 1895-1896.* Vol. 4, No. 2. Echinoidea, pt. 2. Bianco Luno, Copenhagen, 200 pp.

Mortensen, T. (1943) *A Monograph of the Echinoidea. III, 2. Camarodonta. I. Orthopsidæ, Glyphocyphidæ, Temnopleuridæ and Toxopneustidæ*. C. A. Reitzel, Copenhagen, vii + 553 pp.

Mortensen, T. (1950) *A Monograph of the Echinoidea. V, 1. Spatangoida. I. Protosternata, Meridosternata, Amphisternata I. Palæopneustidæ, Palæostomatidæ, Aëropsidæ, Toxasteridæ, Micrasteridæ and Hemiasteridæ*. C. A. Reitzel, Copenhagen, v + 432 pp.

Obuchi, M., Hiratsuka, Y. & Uehara, T. (2013) *Three regular sea urchins (Echinodermata: Echinoidea) from coral reefs at Okinawajima Island, the Ryukyu Islands, Southwestern Japan.* University of the Ryukyus. The University Museum (Fujukan), University of the Ryukyus, 106 pp. [In Japanese]

Smith, A.B. & Kroh, A. (2007) The Echinoid Directory. Available from: http://www.nhm.ac.uk/our-science/data/echinoid-directory/taxa/taxon.jsp?id=1955 (accessed 22 August 2019)

Stara, P. & Sanciu, L. (2014) Analysis of some astriclypeids echinoids (Echinoidea Clypeasteroidea). *Biodiversity Journal*, 5 (2), 291–358.

Shigei, M. (1981) A study on the echinoid fauna of the East China Sea and coastal waters of southern Korea, Kyushu, Ryukyu, and Taiwan. *Publication of Seto Marine Biological Laboratory*, 26, 191–241. https://doi.org/10.5134/176013

Shigei, M. (1986) *The sea urchins of Sagami Bay*. Maruzen, Tokyo, 204 pp.

Troschel, F.H. (1869b) Über einige neue Seeigel. In: Anonymous, Sitzungsberichte. Physikalische Section. Sitzung vom 21. Juni. *Verhandlungen des naturhistorischen Vereines des preussischen Rheinlande und Westphalens*, 26, 96.

Utinomi, H. (1954) A check list of echinoids found in the Kii region. *Publications of the Seto Marine Biological Laboratory*, 3 (3), 339–358. https://doi.org/10.5134/174487

Utinomi, H. (1960) Echinoids from Hokkaido and the neighbouring subarctic waters. *Publications of the Seto Marine Biological Laboratory*, 8 (2), 337–350. https://doi.org/10.5134/174645

Yoshiwara, S. (1898) Preliminary notice of new Japanese echinoids. *Annotationes Zoologicae Japonenses*, 2, 57–61.