

## A NEW SEA-STAR SPECIES (ASTEROIDEA: LUIDIIDAE) FROM THE SOUTH CHINA SEA

**Wei Liu**

*Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, P. R. China;*  
*Graduate School of the Chinese Academy of Sciences, Beijing 100039, P. R. China.*  
*Weifang Marine Environmental Monitoring Central Station of Shandong Province, Weifang 261041, P. R. China.*

**Yulin Liao**

*Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, P. R. China.*

**Xinzheng Li**

*Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, P. R. China.*  
*Email: lixzh@ms.qdio.ac.cn (Corresponding author)*

**ABSTRACT.** – A new sea-star species of family Luidiidae, named *Luidia difficilis*, from the South China Sea is described in the present paper. The diagnostic characters that distinguish *L. difficilis* from its closely allied species *L. hexactis* and *L. maculata* are listed in Table 1.

**KEY WORDS.** – *Luidia difficilis*, new species, Luidiidae, Asteroidea, South China Sea.

---

### INTRODUCTION

Luidiidae Sladen, 1889 is a small family in Asteroidea, including only one valid genus, *Luidia* Forbes, 1839, and 56 valid species (Clark, 1987). There have been few records of Luidiidae from the South China Sea. The South China Sea is a sea enclosed largely by major land masses and island chains, with many channels to connect the West Pacific and Indian Ocean. The first major expedition concerning the fauna of the South China Sea was the renowned world-wide, deep-sea exploring expedition of HMS “Challenger” (1873-1876), two stations of this expedition were set up in the South China Sea, one off the west coast of Luzon and another near Hong Kong (Lane et al., 2000), and the echinoderms from the expedition were reported by Sladen (1889), including 9 Luidiidae species, but no species was collected from the two stations in the South China Sea. Chang et al. (1964) recorded 4 Luidiidae species from the South China Sea, i.e., *Luidia quinaria* von Martens, 1865, *L. prionota* Fisher, 1913, *L. orientalis* Fisher, 1913, *L. maculata* Müller and Troschel, 1842, mainly based on the material collected by the “National Comprehensive Oceanographic Investigation” (1958-1960) (NCOI) and the “Beibu Gulf (Gulf of Tonkin) Comprehensive Oceanographic Survey” (1959-1962), which were the largest oceanographic expeditions in China up to date, and all the material of these two expeditions is deposited in the Institute of Oceanology, Chinese Academy of Sciences, Qingdao,

China (IOCAS). Liao & Clark (1995) recorded 6 Luidiidae species, i.e., *Luidia avicularia* Fisher, 1913, *L. hardwicki* Gray, 1840, *L. longispina* Sladen, 1889, *L. maculata* Müller and Troschel, 1842, *L. orientalis* Fisher, 1913, *L. quinaria* von Martens, 1865 in their monograph “*The Echinoderms of Southern China*”, which made extensive studies of the echinoderm fauna of the sea off southern China. The majority of the material they studied on is the collections of the IOCAS collected since 1950’s from the coast off the southern China, including the coast of Fujian and Guangdong Provinces, Beibu Gulf, Hainan Island, Xisha Islands, and minor contributions of A. M. Clark. Recently, Lane et al. (2000) made a comprehensive review and analysis of the literature on echinoderm records for the South China Sea, recording 10 Luidiidae species, besides those species reported by Liao & Clark (1995), other 4 species, *Luidia aspera* Sladen, 1889, *L. magnifica* Fisher, 1913, *L. penangensis* de Loriol, 1891, *L. savignyi* (Audouin, 1826), were also included. They pointed out that the large areas of the South China Sea remained unexplored biologically and it is likely to discover additional records and new taxa of echinoderms.

Recently, when we sorted the Luidiidae material from the China Seas deposited in the IOCAS, two very unique 6-rayed specimens from the Beibu Gulf which are not covered by the descriptions of the known species, were separated out and considered and described as a new species here.

## MATERIAL AND METHODS

The specimens examined in this study are deposited in the IOCAS. Beibu Gulf is the new name for the Tonkin Gulf. The following abbreviations are used in the text: "CN" is used in "Material examined" under each species account refers to the preliminary registration number of collection; AT: Agassiz trawl; coll. : collector(s). Terminology follows that defined in the glossary and illustrations of Clark and Rowe (1971: 27-28).

## TAXONOMY

### *Luidia difficilis*, new species

(Figs. 1-2)

**Material examined.** – Holotype – CN IOCAS-E 1108, Beibu Gulf, [19°32'N 106°30'E], 32 m, sand, AT, 15 Apr.1962.

Paratype – 1 example, CN IOCAS-E 1109, same locality and date as holotype.

**Diagnosis.** – Arms 6. Large abactinal paxillae squarish or rectangular, with 3-20 fine central granules and 10-20 peripheral spinelets. Most lateral spines are less than a millimeter in length, flattened and obliquely appressed on the inferomarginal plates. Adambulacral armature consists typically of 1 large furrow spine and 3 large spines on surface of plate. Pedicellariae is absent at oral end of mouth-plates. Ventrolateral plates with large tricuspid pedicellariae.

**Description.** – Arms 6. R= 79.2 mm; r= 9.7 mm; br= 10.5 mm; R/r =8.2. Disk relatively small and arms slender. Marginal paxillae representing superomarginals squarish or rectangular and similar to adjacent abactinal paxillae. Paxillae in 5 longitudinal series on each side of arm; squarish or rectangular, with sides proximately 0.6-0.8 mm wide and 0.9-1.0 mm long. At the arm base such series increased to 6. Side rows above mentioned form lateral borders of arms. Spherical surface of paxillae covered with 3-20 fine central granules about 0.2mm high and 0.17mm wide, 10-20 peripheral column spinelets and several intermediate spines between centrals and peripherals. Centrals short, rounded and granuliform, peripherals much more slender and subequal to centrals in length. Adjacent to lateral paxillae series are 5 more series, somewhat irregular, little rounded and smaller. Near the tips of arms, paxillae still smaller and less regularly arranged. Arms fairly high at base, about 10 mm, and disc higher than arms.

Inferomarginals relatively short and wide, and coincident with adambulacrals. About 10 plates in 9.5 mm of arm-length, while their width is about 2.5 mm. Surface well covered with longitudinal rows of squamiform spines and a large number of much smaller spinelets. Abactinal row of spines larger, sometimes 1-2 spines subequal to the lateral one; actinal row of spines smaller. The largest spine situated on outer end of the plate is obliquely appressed on the plate and indistinct in dorsal view. Most are less than a millimeter in

length, wide at base but gradually attenuate to an acute tip; close to it, but sometimes below, is a second spine of subequal size, and still further abactinally are spinelets similar to those of the abactinal paxillae but larger and more pointed. Along the margin of inferomarginals is a series of small spinelets. The fasciolar grooves covered in the inner part with capillary spinelets. At and near interbrachial angle the spines and spinelets much more slender and acute.

Adambulacrals coincident with inferomarginals and ventrolaterals and present a wedged shaped edge towards ambulacral furrow. Rarely one adambulacral plate coincident with 2 ventrolaterals and 2 inferomarginals. The armature consists typically of four spines. The first one, laterally compressed, curved, and hookshaped, lies well within furrow; about 0.8 mm long and 0.3 mm wide at the base. The second one, largest, also lightly curved, but much more stout and somewhat triangular in cross-section; about 1.2 mm long and 0.4 mm wide at the base. Then follows the third and fourth, straight and of proximately coniform with blunt tips, about two-thirds the length of second one; the two in a line parallel to the furrow, and a notch present at the base on the inner side facing furrow. On outer side of large spines may be 8 smaller spines varying in length and in shape. First and subsequent 2-7 adambulacrals with somewhat different armature from the rest. The armature of first consists of about 7 large spines; subsequent 2-7 adambulacrals with 1-2 furrow spines and 4-5 larger spines on the surface of plates.

Mouth-plates somewhat narrow and long with an interspace covered over with a membrane. The most characteristic point in the armature of mouth-plates is the absence of any pedicellariae at oral end of plates. About 12 large spines in a series along main ridge of plate, much larger at the oral end. Secondary ridge of plate bearing about 8 much smaller spines, which become smaller towards distal part of the plate. Facing first adambulacral plate about 10 spinelets are found at the outer side of spines on the main ridge. Usually a series of about 9 subequal but much shorter spinelets on the side of each oral plate, deep in the mouth.

Ventrolateral plates very small, and 2 or 3 plates situated in each interradial area between mouth plates and first inferomarginals. Each plate with about 8-20 slender spinelets, which are similar to those on outer part of adambulacrals. Subsequently are series of 3-4 pairs plates on each side, only a series of plates extending to the tip of arms, and becoming somewhat indistinct in distal part owing to their fusion with inferomarginals. Most plates have one large pedicellariae with 3 long and slender jaws, which are thicker and obtuser than peripheral spinelets. Similar pedicellariae have not been found elsewhere. On dry ray of paratype, with surface cleared, the plates at proximal base of ray large and triangular, bearing granule prominence at the top.

Terminal plates relatively small, usually colourless. Madreporite completely hidden from view by surrounding paxillae, which are similar to adjacent ones, so difficult to distinguish.

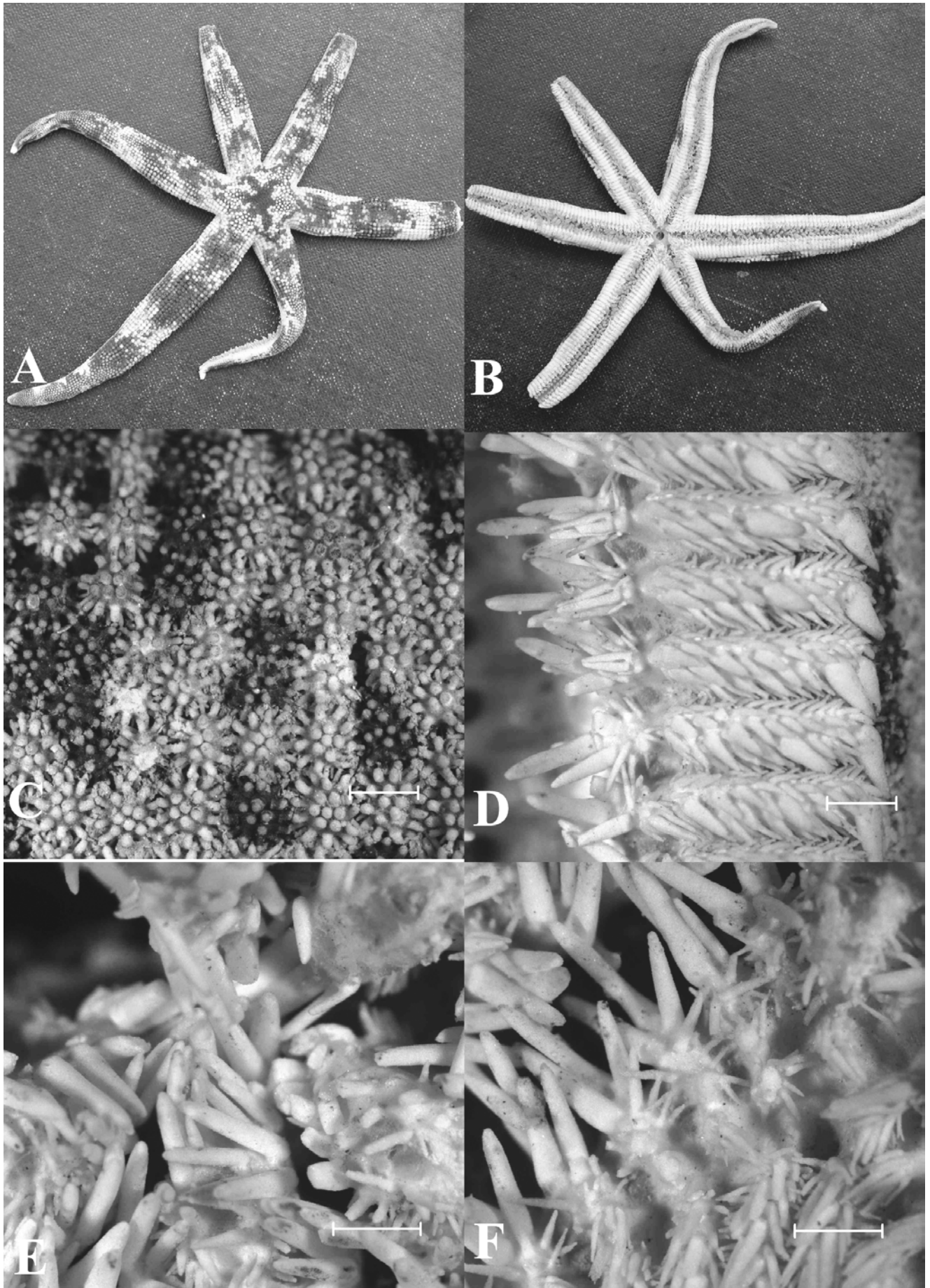


Fig. 1. *Luidia difficilis*, new species. A, holotype, dorsal view; B, holotype, ventral view; C, paratype, abactinal paxillae, dry; D, paratype, adambulacrals and inferomarginals, dry; E, paratype, mouth-plates, dry; F, paratype, ventrolaterals of the arm base, dry. Scale bar = 1.0 mm.

**Body colour.** – Color in alcohol preserved specimens very similar to that of *L. hexactis* and *L. maculata*. Oral surface very light, proximally fawn; dorsal surface light buff blotched and marked with large irregular dark areas.

**Etymology.** – From Latin *difficilis*, to imply the species was difficult to align to any described species of *Luidia*.

**Remarks.** – This is a very well marked species for while it seems to belong to *Luidia alternata* group of Döderlein (1920). By comparison the seven species of *Luidia* in the China seas (Chang, 1948; Chang et al., 1964; Liao & Clark, 1995), eight shallow-water *Luidia* species from the Indo-West Pacific (Clark & Rowe, 1971), 10 species of *Luidia* from the South China Sea (Lane et al., 2000), and five species of *Luidia* from New Zealand (Clark & McKnight, 2000), we found that *L. difficilis*, new species superficially resembles *L. hexactis* Clark, 1938 (type locality near the Montgomery Reef) and *L. maculata* Müller and Troschel, 1842 (type locality Southern Japan). The diagnostic characters that distinguish *L. difficilis* from *L. hexactis* and *L. maculata* are listed in Table 1. The characters of *L. hexactis* are according to the descriptions and illustrations of Clark (1938: 73-74, Pl. 17 Fig. 1) and Clark & Rowe (1971: 43); the characters of *L. maculata* are according to the descriptions and illustrations of Sladen (1889: 327), Fisher (1919: 163, 168), Döderlein (1920: 262, Pl. 18 Figs. 4, 13, Pl. 19 Fig. 16, Pl. 20 Figs. 23, 24) and Hayashi

(1973: 48, Pl. 7 Fig. 4), and also based on the specimens as follows:

**Comparative material.** – *Luidia maculata* Müller & Troschel, 1842: 1 example, CN Q47B-9, [18°15'N, 109°E], muddy sand, AT, coll. Fan, 11 Apr.1959; 1 example, CN K51B-7, [20°N 112°E], muddy sand, AT, coll. Ma, 3 Jul.1959; 1 example, CN K124B-3, [20°N 112°30'E], muddy sand, AT, coll. Qu, 8 Feb.1960; 1 example, CN N155B-27, [18°N 109°E], sand, 32.5 m, AT, coll. Liu, 12 Mar.1960; 1 example, CN Q162B-68, [21°22'N 109°E], sand, 12 m, coll. Sun, 17 Feb.1960; 3 example, CN N207B-120, [18°15'N, 109°15'E], muddy sand, 24 m, AT, coll. Shen, 14 May.1960; 1 example, CN X215B-63, [20°22'N 109°38'E], sand, 32 m, 22 Apr.1962; 1 example, CN X277B-38, [19°N 106°30'E], sand, 43 m, 11 Oct.1962.

#### ACKNOWLEDGMENTS

We are grateful to Mr. Shaoqing Wang, Mr. Yongqiang Wang, Miss Lianmei Shuai, Miss Shiling Li and Mr. Baoquan Li in our lab, for their kindly help when we sorted the samples. The study was financially supported by the Project of the Developing Plan of the Science and Technology of Shandong Province, China (No. 031070119) and the National Special Program of China (no. 2003DEA6N041).

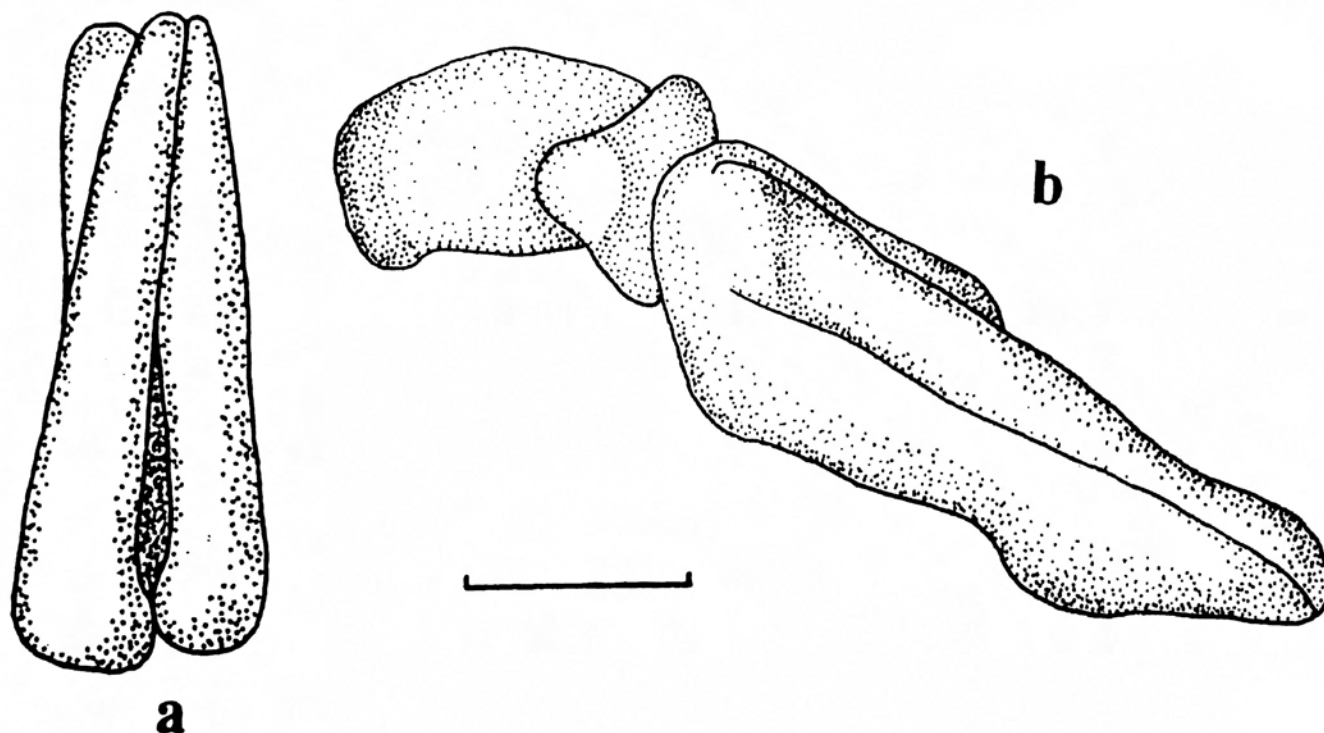


Fig. 2. *Luidia difficilis*, new species: a, tricuspid pedicellaria of ventrolaterals; b, large triangular ventrolateral plate at proximal arm base and corresponding adambulacral plate and inferomarginal plate, plates surface cleared. Scale bar: a = 2.0 mm; b = 0.8 mm.

Table 1. Comparison of diagnostic characters of *Luidia difficilis*, new species, *L. hexactis* and *L. maculata*.

Characters	<i>L. difficilis</i>	<i>L. hexactis</i>	<i>L. maculata</i>
Arms	Six	Six	Seven to nine
Inferomarginal plates	Lateral spine small, gradually attenuate; no pedicellariae	Lateral spine long, rapidly attenuate; no pedicellariae	Lateral spine long, slender; one or more bicuspid pedicellariae
Adambulacral plates	Four large spines, no pedicellariae	Four large spines, one or more bicuspid pedicellariae	Three large spines, one or two tricuspid pedicellariae
Ventrolateral plates	Large, one tricuspid pedicellariae	Only two on each side, one bicuspid pedicellariae	Very small, no pedicellariae

## LITERATURE CITED

- Audouin, V., 1826. Explication sommaire des planches d'Echinodermes de l'Egypte et de la Syrie, publiées par J. C. de Savigny. In: J. C. de Savigny, *Description de l'Egypte. Histoire naturelle*. Paris. **1**(4): 203-212.
- Chang, F. Y., 1948. Echinoderms of Tsingtao. *Contributions from the Institute of Zoology National Academy of Peiping*, **4**: 33-104.
- Chang, F. Y., Y. L. Liao, B. Wu & L. Chen, 1964. *Illustrated Fauna of China*. Science Press, Beijing. Pp. 51-73. (In Chinese).
- Clark, A. M., 1987. An index of names of recent Asteroidea-Part 1: Paxillosida and Notomyotida. *Echinoderm Studies*, **3**: 236-249.
- Clark, A. M. & J. Courtman-Stock, 1976. *The Echinoderms of southern Africa*. British Museum (Natural History), London. Pp. 22-97, Figs. 22-85.
- Clark, A. M. & F. W. E. Rowe, 1971. *Monograph of the shallowwater Indo-West Pacific Echinoderms*. British Museum (Natural History), London. Pp. 27-74, Figs. 10-19.
- Clark, H. E. S. & D. G. McKnight, 2000. The marine fauna of New Zealand: Echinodermata: Asteroidea (Sea-Stars), Orders Paxillosida. *NIWA Biodiversity Memoir*, **116**: 14-135.
- Clark, H. L., 1938. Echinoderms from Australia. *Memoirs of the Museum of Comparative Zoology*, **55**: 1-596.
- de Loriol, P., 1893. Echinodermes de la Baie d'Amboine. *Revue Suisse de Zoologie*, **1**: 359-426.
- Döderlein, L., 1920. Die Asteriden der 'Siboga' Expedition. II. Die Gattung *Luidia* und ihre Stammesgeschichte. *Siboga Expeditie*, **46b**: 193-291, Figs. 1-37.
- Fisher, W. K., 1913. New starfishes from the Philippines Islands, Celebes and the Moluccas. *Proceedings of the United States National Museum*, **46**: 201-224.
- Fisher, W. K., 1919. Starfishes of the Philippine Seas and adjacent waters. *Bulletin of the United States National Museum*, **100** (3): i-xii, 1-711, 156 pls.
- Forbes, E., 1839. On the Asteroidea of the Irish Sea. *Memoirs of the Wernerian Natural History Society, Edinburgh*, **8**: 114-129.
- Gray, J. E., 1840. A synopsis of the genera and species of the class Hypostoma (Asterias Linn.). *The Annals and Magazine of Natural History*, **6**: 175-184, 275-290.
- Hayashi, R., 1973. *The sea-stars of Sagami Bay*, collected by His Majesty the Emperor of Japan. Biology Laboratory, Imperial Household, Tokyo. Pp. 41-53, Pl. 7, Figs. 1-6.
- Lane, D. J. W., L. M. Marsh, D. VandenSpiegel & F. W. E. Rowe, 2000. Echinoderm fauna of the South China Sea: an inventory and analysis of diatribution patterns. *Raffles Bulletin of Zoology*, Supplement **8**: 459-493.
- Liao, Y. L. & A. M. Clark, 1995. *The echinoderms of southern China*. Science Press, Beijing. Pp. 63-74, Pl. 3, Figs. 1-38.
- Müller, J. & F. H. Troschel, 1842. *System der Asteriden*. Braunschweig. xx + 134 pp. 12 pls.
- Sladen, W. P., 1889. Report on the Asteroidea collected by H.M.S. Challenger. *Zoology*, **30**: xlii+893, 117 pls.
- von Martens, E., 1865. Ueber östasiatische Echinodermen. *Archiv für Naturgeschichte*, **31**: 345-360.