

A Systematic Study on the Asteroidea in the East Sea, Korea

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ABSTRACT

Twenty-nine species of asteroids are reported to be distributed in the East Sea of Korea. Five species are reported for the first time in Korea: *Solaster endeca* (Linné, 1771), *Lethasterias fusca* D'yakonov, 1931, *Lethasterias nanimensis chelifera* (Verrill, 1914), *Lysastrosoma anthosticta* Fisher, 1992 and *Evasterias troscheli alveolata* Verrill, 1914. The faunal composition and distribution of the asteroids in the East Sea of Korea are discussed.

Key words: Systematics, Asteroidea, East Sea, Korea

INTRODUCTION

Asteroidea is one of the five major taxa composing Echinodermata. Asteroids play an important role in marine ecosystem as benthos and is mainly distributed in the neritic ocean and particularly abundant in the North Pacific Ocean. Therefore the systematic study on asteroids has been actively carried out from the 18th century throughout the world and more than 1,600 species have come to be known from all over the world up to the present time.

In Korea the fragmentary study on asteroids has been done from the end of 19th century and 43 species have so far been reported in South Korea (Sladen, 1879; Sato, 1936; Kamita, 1938; Hayashi, 1939; Rho and Kim, 1966; Rho, 1971; Rho and Shin, 1980; Shin, 1992). Among them 23 species of asteroids are reported to be found in the East Sea. This study is made on the faunal studies of Asteroidea, which has not been well studied in the East Sea, as a part of a series of the Korean asteroid fauna.

MATERIALS AND METHODS

The asteroid specimens used in this work are collected from 36 localities in the East Sea during the period from April, 1990 to August, 1993 (Fig. 1). The materials are collected by the author in the

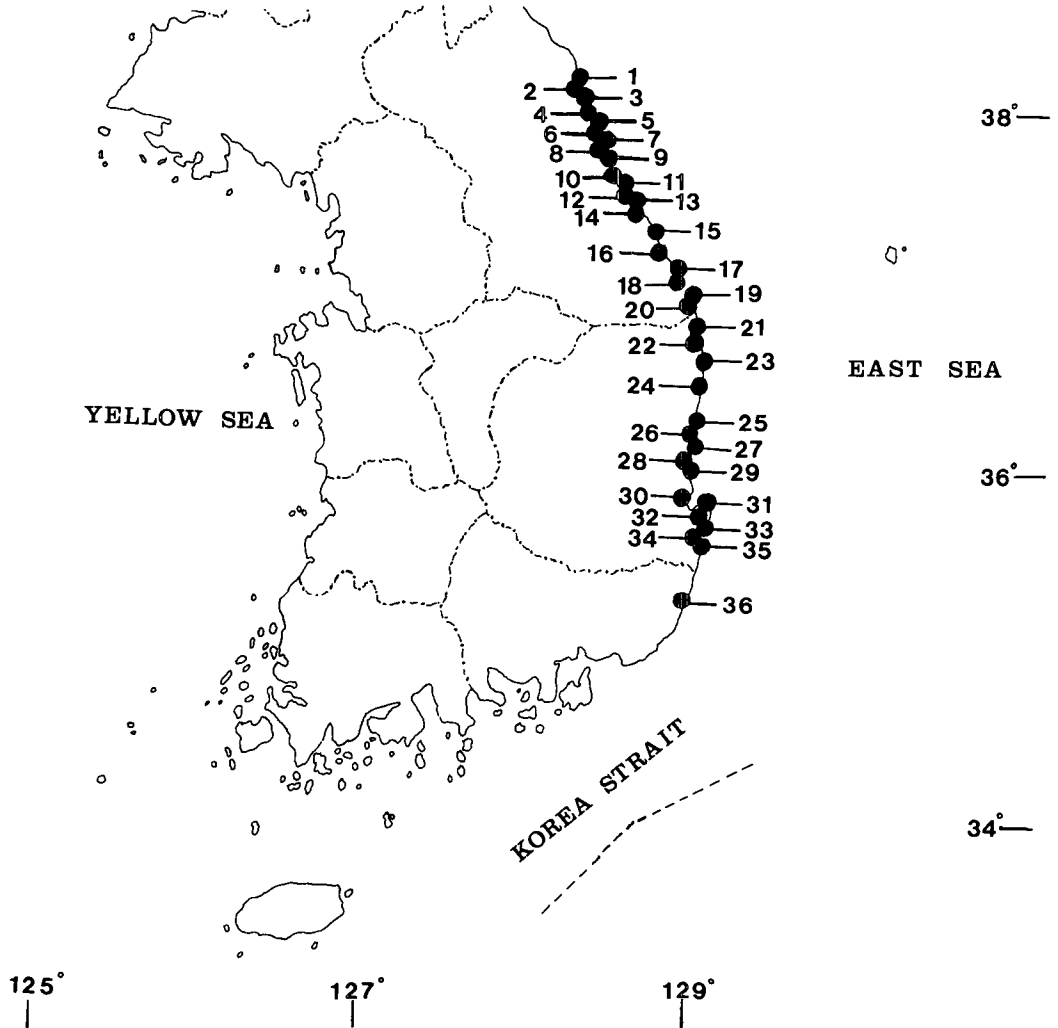


Fig. 1. A map showing the localities where the materials were collected.

1. Kōjin(거진), 2. Panam(반암), 3. Kajin(가진), 4. Oho(오호), 5. Ayajin(아야진), 6. Dongmyung-hang, Sokch'o(속초 동명항), 7. Sokch'o(속초), 8. Taep'o(대포), 9. Susan(수산), 10. Kisamun(기사문), 11. Namae(남애), 12. Chumunjin(주문진), 13. Sachŏn(사천), 14. Kangmun(강문), 15. Okkye(옥계), 16. Mukho(목호), 17. Samchŏk(삼척), 18. Changho(장호), 19. Imwon(임원), 20. Chukpyŏn(죽변), 21. Hyunrae(현래), 22. Osan(오산), 23. Hup'o(후포), 24. Ch'uksan(축산), 25. Ch'ahyu(차유), 26. Ch'angp'o(창포), 27. Kanggu(강구), 28. Pangŏ(방어), 29. Walp'o(월포), 30. P'ohang(포항), 31. Kuryongp'o(구룡포), 32. Hwajŏng(화정), 33. Mop'o(모포), 34. Yangp'o(양포), 35. Kamp'o(감포), 36. Pangŏjin(방어진)

intertidal zone and by scuba diving and using the fishing nets in the subtidal zone. All samples are preserved in 75% methyl alcohol and are deposited in the Department of Biology, Korean Sahmyook University, Korea. These specimens are identified on the basis of their morphological characteristics according to the systems of Fell (1962, 1984) and Tommasi (1970). The diagnostic features on the species which are not reported in Korea are briefly described and the plates on the characteristics of species are prepared by using stereomicroscope. And the distribution of asteroids is discussed on the basis of the number of species and the number of specimens collected in each region. The distribution type according to ocean and water forms are also reviewed by considering the distribution area reported in the literature already published.

RESULTS AND DISCUSSION

The identification of total 820 individuals collected from 36 localities demonstrated that Asteroidea distributed in the coastal area of the East Sea, Korea consists of 29 species, of which five species, *Solaster endeca* (Linné, 1771), *Lethasterias fusca* D'yakonov, 1931, *Lethasterias nanimensis chelifera* (Verrill, 1914), *Lysastrosoma anthosticta* Fisher, 1922 and *Evasterias troscheli alveolata* Verrill, 1914 are reported for the first time in Korea. These 29 species could be classified into 5 orders: Spinulosa has the largest number of 12 species in 4 families; Forcipullata, 9 species in 1 family; Parillosida, 6 species in 1 family; Platyasterida 1 species in 1 family; and Valvatida, 1 species in 1 family.

Systematic Account

Phylum Echinodermata Klein, 1734 극피동물문
 Class Stelleroidea Lamarck, 1816 성형강
 Subclass Asteroidea de Blainville, 1830 불가사리아강
 Order platyasterida Spencer, 1951, 편평불가사리목
 Family Luidiidae Verrill, 1839 검은띠불가사리과
 Genus *Luidia* Forbes, 1839 검은띠불가사리속

1. *Luidia quinaria* von Martens, 1865 검은띠불가사리

Material examined. Kajin, 23 July 1992, 1 specimen; Sokch'o, 13 Aug. 1991, 1 specimen; 15 Oct. 1991, 1 specimen; Taep'o, 14 Aug. 1991, 4 specimen; 22 July 1992, 1 specimen; Susan, 14 Aug. 1991, 2 specimens; 24 July 1992, 1 specimen; Kisamun, 16 Oct. 1991, 4 specimens; 11 Aug. 1992, 6 specimens; Namae, 14 Aug. 1991, 1 specimen; Kuryongp'o, 20 Oct. 1991, 4 specimens; 15 Dec. 1992, 2 specimens; Hajong, 20 Oct. 1991, 1 specimen; Mop'o, 20 Oct. 1991, 4 specimens; 16 Dec. 1992, 1 specimen; Yangp'o, 20 Oct. 1991, 3 specimens.

Remarks. This species is newly reported in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait, Yellow Sea), Japan (Southern part of Hokkaido - Kyushu), Kwangdung Peninsula and Indo Pacific Ocean.

Order Paxillosida Perrier, 1884 소주불가사리목
 Family Astropectinidae Gray, 1840 가시불가사리과

Genus *Ctenodiscus* Müller et Troschel, 1842 빗살판불가사리속

2. *Ctenodiscus crispatus* (Retzius, 1805) 빗살판불가사리

Material examined. Kajin, 22 July 1992, 4 specimen; Dongmyung-hang, 24 July 1992, 2 specimen; Sokch'o, 10 Aug. 1992, 21 specimens; Okkye, 17 Oct. 1991, 1 specimen; Imwon, 18 Oct. 1991, 1 specimen; 12 Aug. 1992, 3 specimens; Changho, 13 Aug. 1992, 1 specimen.

Distribution. Korea (East Sea), Japan (Sea of Japan, Pacific coast of northern Japan), North Pacific Ocean (Okhotsk Sea - Bering Sea - Panama Bay), Arctic Ocean and North Atlantic Ocean.

Genus *Leptychaster* Smith, 1876 작은불가사리속

3. *Leptychaster arcticus* (Sars, 1851) 작은불가사리

Material examined. Sokch'o, 13 Aug. 1991, 1 specimen; 16 Oct. 1991, 1 specimen; 22 July 1992, 1 specimen; 10 Aug. 1992, 3 specimens.

Distribution. Korea (East Sea), Japan (Sea of Japan, Yezo Strait), North Pacific Ocean (Okhotsk Sea - Bering Sea), Arctic Ocean and North Atlantic Ocean.

4. *Leptychaster anomalus* Fisher, 1906 울통작은불가사리

Material examined. Sokch'o, 16 Oct. 1991, 2 specimens; 22 July 1992, 1 specimen; 11 Aug. 1992, 1 specimen; Chukpyon, 18 Oct. 1992, 1 specimen.

Distribution. Korea (East Sea), Japan, North Pacific Ocean (Okhotsk Sea - Bering Sea - Northeast Alaska), Monterey Bay and California.

Genus *Dipsacaster* Alcock, 1893 마른불가사리속

5. *Dipsacaster pretiosus* (Döderlein, 1902) 마른불가사리

Material examined. Changho, 13 Aug. 1992, 1 specimen; Imwon, 16 Oct. 1991, 1 specimen.

Remarks. This species is newly reported in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait, Cheju Island), Japan and Indo Pacific Ocean.

Genus *Astropecten* Gray, 1840 가시불가사리속

6. *Astropecten polyacanthus* Müller et Troschel, 1842 가시불가사리

Material examined. Ch'angp'o, 19 Oct. 1991, 1 specimen; Wolp'o, 19 Oct. 1991, 1 specimen; Kuryongp'o, 15 Dec. 1992, 1 specimen; Yangp'o, 20 Oct. 1991, 1 specimen; 16 Dec. 1992, 1 specimen; Kamp'o, 20 Oct. 1991, 1 specimen; Pangojin, 19 Dec. 1992, 1 specimen.

Remarks. This species is newly reported in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait), Japan, Indo-West Pacific Ocean, Rea Sea and East Africa.

7. *Astropecten kagoshimensis* De Loriol, 1899 가고시마가시불가사리

Material examined. Yangp'o, 16 Dec. 1992, 1 specimen

Distribution. Korea (East Sea) and Japan (Toyama Bay, Pacific coast of southern Japan).

Order Valvatida Perrier, 1884 연변불가사리목

Family Goniasteridae Forbes, 1841 뽕족불가사리과

Genus *Pseudarchaster* Sladen, 1885 헛불가사리속

8. *Pseudarchaster parelii* (Düben & Korem, 1846) 헛불가사리

Material examined. Chumunjin, 16 Oct. 1991, 2 specimens; Changho, 13 Aug. 1992, 1 specimen; 17 Oct. 1992, 2 specimens; Imwon, 17 Oct. 1992, 7 specimens; Hup'o, 19 Oct. 1991, 1 specimen; Ch'uksan, 19 Oct. 1991, 2 specimens.

Distribution. Korea (East Sea), Japan (Sea of Japan), North Pacific Ocean (Okhotsk Sea - Bering Sea - Kadiac Island), Artic Ocean and North Atlantic Ocean.

Order Spinulosa Perrier, 1894 유극불가사리목

Family Asterinidae Gray, 1840 별불가사리과

Genus *Asterina* Nardo, 1834 별불가사리속

9. *Asterina pectinifera* Müller et Troschel, 1842 별불가사리

Material examined. Panam, 23 July 1992, 2 specimen; Kajin, 23 July 1992, 2 specimen; Oho, 23 July 1992, 1 specimen; Ayajin, 12 Aug. 1991, 2 specimens; Dongmyung-hang, 10 Aug. 1992, 3 specimens; Sachon, 12 Aug. 1992, 1 specimen; Sokch'o, 13 Aug. 1991, 3 specimens; 10 Aug. 1992, 4 specimens; Taep'o, 22 July 1992, 3 specimens; 13 Aug. 1993, 10 specimens; Susan, 14 Aug. 1991, 1 specimen; 24 July 1992, 1 specimen; Kisamun, 14 Aug. 1991, 1 specimen; 16 Oct. 1991, 16 specimens; Namae, 16 Oct. 1991, 3 specimens; 11 Aug. 1992, 5 specimens; Chumunjin, 14 Aug. 1991, 1 specimen; Kangmun, 16 Aug. 1991, 2 specimen; Chukpyon, 18 Oct. 1992, 2 specimens; Okkye, 17 Oct. 1991, 7 specimens; Changho, 18 Oct. 1991, 2 specimen; 12 Aug. 1992, 3 specimens; Imwon, 12 Aug. 1992, 1 specimen; 17 Oct. 1992, 6 specimen; Chukpyon, 18 Oct. 1991, 2 specimens; Hyunrae, 18 Oct. 1991, 2 specimens; Osan, 18 Oct. 1992, 2 specimen; Hup'o, 18 Oct. 1992, 4 specimens; Ch'ahyu, 19 Oct. 1991, 42 specimen; Ch'angp'o, 19 Oct. 1991, 1 specimen; Kanggu, Oct. 19, 1991, 2 specimen; Wolp'o, 19 Oct. 1991, 3 specimens; Kuryongp'o, 20 Oct. 1991, 3 specimens; Hajong, 20 Oct. 1991, 1 specimen; 15 Dec. 1992, 1 specimen; Mop'o, 20 Oct. 1991, 1 specimen; Yangp'o, 20 Oct. 1991, 3 specimens; 16 Dec. 1992, 2 specimens; Pangojin, 17 Dec. 1992, 3 specimens.

Remarks. This is the most common species collected at 31 localities of total 36 localities examined in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait, Cheju Island, Yellow Sea), Japan (Hokkaido - Kyushu), Poseta Bay, Tatar Strait and Sakhalin.

Family Echiniasteridae Verrill, 1867 애기불가사리과

Genus *Henricia* Gray, 1840 애기불가사리속

10. *Henricia leviuscula* (Stimpson, 1857) 미끈애기불가사리

Material examined. Namae, 16 Oct. 1991, 1 specimen; Chumunjin, 14 Aug. 1991, 1 specimen.

Remarks. This species is newly reported in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait), Japan (Mutsu Bay, Sea of Japan) and North Pacific Ocean (Yakutat - Bering Sea - Monterey Bay).

11. *Henricia reniessa* Hayashi, 1940 콩팍애기불가사리

Material examined. Namae, 12 Aug. 1992, 1 specimen.

Distribution. Korea (East Sea) and Japan (Sea of Japan, Yezo Strait).

12. *Henricia regularis* Hayashi, 1940 네모애기불가사리

Material examined. Namae, 16 Aug. 1991, 1 specimen; Imwon, 16 Oct. 1991, 1 specimen.

Distribution. Korea (East Sea, Korea Strait, Cheju Island) and Japan (Uraga, Goto Island).

13. *Henricia nipponica* Uchida, 1928 애기불가사리

Material examined. Dongmyung-hang, 14 Aug. 1992, 1 specimen; Taep'o, 15 Oct. 1991, 1 specimen; Namae, 16 Aug. 1991, 1 specimen; Chumunjin, 14 Aug. 1991, 1 specimen; Sachon, 12 Aug. 1992, 1 specimen; Changho, 18 Oct. 1991, 1 specimen; Imwon, 17 Oct. 1992, 2 specimen; Hup'o, 18 Oct. 1992, 1 specimen; Ch'angp'o, 19 Oct. 1991, 1 specimen; Wolp'o, 19 Oct. 1991, 1 specimen.

Distribution. Korea (East Sea, Korea Strait, Cheju Island) and Japan (Southern Honshu, Hokkaido).

14. *Henricia pachyderma* Hayashi, 1940 육질애기불가사리

Material examined. Taep'o, 22 July 1992, 1 specimen; 12 Aug. 1992, 1 specimen; Chumunjin, 14 Aug. 1991, 2 specimens; 16 Oct. 1991, 1 specimen.

Distribution. Korea (East Sea, Korea Strait), Japan (Sea of Japan, Pacific coast of Honshu), Peter the Great Bay, Tatar Strait, Aniva Bay and Okhotsk Sea.

Genus *Poraniopsis* Perrier, 1888 부푼불가사리속

15. *Poraniopsis inflata* (Fisher, 1906) 부푼불가사리

Material examined. Chumunjin, 12 Aug. 1992, 1 specimen; Hup'o, 19 Oct. 1991, 1 specimen.

Distribution. Korea (East Sea), Japan (Northern Honshu, Toyama Bay) and Oregon - San Diego.

Family Solasteridae Forbes, 1839 햇님불가사리과

Genus *Solaster* Forbes, 1839 햇님불가사리속

16. *Solaster endeca* (Linné, 1771) 넓은햇님불가사리(신칭) (pl. 1)

Asterias endeca Linné, 1771, p. 543.

Solaster endeca Fisher, 1911, p. 307, pl. 81, figs. 1, 2, 4; Verrill, 1914, p. 244, pl. 9, figs. 4-4b, pl. 89, fig. 1; Hayashi, 1939, p. 297, pl. 23, figs. 5-7; Hayashi, 1940, p. 175; D'yakonov, 1950, p. 57.

Material examined. Namae, 16 Oct. 1991, 1 specimen.

Diagnosis. Disk large, arm short and so the ratio of length about 2.7. Arm eight in number.

Description. R = 93 mm, r = 34 mm, R = 2.7 r. Disk large and arm rather short, broad at the base and eight in number. Aboral paxillae small and crowded, each composed of five to ten skin-covered spinelets. Paxillae on the sides of arm a little larger than those on disc and the midradial portion of arm. Papular areas small and each has one or two papulae. Interradial area somewhat large and reaches to the middle portion of arm. Suferomarginal plates close to the inferomarginal plates, smaller than the inferomarginals but larger than the adjacent abactinal plates and carrying about 13 to 15 spinelets. Inferomarginals distinctly larger than the others and each covered with about 20 small spinelets. Subambulacral comb not straight and composed of four to six skin-covered spines gradually

decreasing in length from the inner ones toward the outer ones. Furrow spines conspicuously shorter than subambulacral spines, two in the proximal portion of arm but only one in the distal portion of arm. In the case of two subequal spines, the adoral one usually slender and shorter. Mouth plates with five or six oral spine and four suboral spines in a series. Colour orange but dark violet bands in margin of disk and base of arms.

Remarks. This species is newly reported for the Korean fauna.

Distribution. Korea (East Sea), Japan (Sea of Japan), Peter the Great Bay, Tatar Strait, Aniba Bay, North Pacific Ocean (Okhotsk Sea - Bering Sea - Puget Sound), Arctic Ocean and North Atlantic Ocean.

17. *Solaster dawsoni* Verrill, 1880 도우손햇님불가사리

Material examined. Taep'o, 15 Oct. 1991, 1 specimen; 22 July 1992, 1 specimen; Namae, 12 Aug. 1992, 4 specimens; Changho, 17 Oct. 1992, 2 specimen; Imwon, 17 Oct. 1992, 2 specimens; Wolp'o, 19 Oct. 1991, 3 specimens.

Distribution. Korea (East Sea, Korea Strait, Yellow Sea), Japan (Northern Honshu, Hokkaido) and North Pacific Ocean (Kurile Island - Bering Sea - Aleutian Island - Monterey Bay).

18. *Solaster uchidai* Hayashi, 1939 우치다햇님불가사리

Material examined. Namae, 14 Aug. 1991, 2 specimens; 16 Oct. 1991, 1 specimen; Kuryongp'o, 15 Dec. 1992, 1 specimen; Hajong, 20 Oct. 1991, 1 specimen.

Remarks. This species is newly reported in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait), Japan (Honshu) and East China Sea.

Genus *Crossaster* Müller et Troschel, 1840 주름불가사리속

19. *Crossaster papposus* (Linné, 1767) 주름불가사리

Material examined. Dongmyung-hang, 22 July 1992, 1 specimen; 11 Aug. 1992, 1 specimen; Sokch'o, 11 Aug. 1991, 2 specimen; 16 Oct. 1991, 1 specimen; Taep'o, 15 Oct. 1991, 3 specimens; 22 July 1992, 1 specimen; 10 Aug. 1992, 3 specimen; Namae, 16 Aug. 1991, 3 specimens; 16 Oct. 1991, 4 specimens; 12 Aug. 1992, 3 specimens; Chumunjin, 14 Aug. 1991, 2 specimen; 16 Oct. 1991, 2 specimens; Okkye, 17 Oct. 1991, 1 specimen; 12 Aug. 1992, 1 specimen; Mukho, 18 Oct. 1991, 1 specimen; Changho, 17 Oct. 1991, 2 specimen; 13 Aug. 1992, 2 specimens; Imwon, 17 Oct. 1991, 4 specimens; 12 Aug. 1992, 2 specimens; Hyunrae, 18 Oct. 1992, 2 specimens; Hup'o, 18 Oct. 1992, 3 specimens; Ch'uksan, 19 Oct. 1991, 2 specimens; Ch'angp'o, 19 Oct. 1991, 1 specimen; Ch'ahyu, 19 Oct. 1992, 8 specimens; Kuryongp'o, 20 Oct. 1991, 1 specimen; Hajong, 20 Oct. 1991, 1 specimen; Yangp'o, 20 Oct. 1991, 2 specimens.

Remarks. This is also a common species collected at 19 localities of total 36 localities examined in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait), Japan (Sea of Japan, Pacific coast of Honshu), North Pacific Ocean (Okhotsk Sea - Bering Sea - Washington), Arctic Ocean and North Atlantic Ocean.

Family Pterasteridae Perrier, 1875 입방불가사리과

Genus Pteraster Müller et Troschel, 1842 입방불가사리속

20. *Pteraster tessellatus Ives, 1888* 입방불가사리

Material examined. Namae, 14 Aug. 1991, 1 specimen; Chumunjin, 16 Oct. 1991, 1 specimen; 12 Aug. 1992, 1 specimen.

Distribution. Korea (East Sea); Japan (Tosa Bay, Northern Honshu) and North Pacific Ocean (Sakhalin - Bering Sea - Washington).

Order Forcipulata Perrier, 1884 차극불가사리목

Family Asteriidae Gray, 1840 불가사리과

Subfamily Labidiasterinae Verrill, 1914 외극불가사리아과

Genus *Plazaster* Fisher, 1941 문어다리불가사리속

21. *Plazaster borealis (Uchida, 1928)* 문어다리불가사리

Material examined. Sokch'o, 13 Aug. 1991, 3 specimens; Taep'o, 22 July 1992, 1 specimen; 13 Aug. 1993, 1 specimen; Okkye, 17 Oct. 1991, 1 specimen; Changho, 13 Aug. 1992, 1 specimen; Imwon, 17 Oct. 1991, 1 specimen; Hup'o, 18 Oct. 1991, 2 specimens; Ch'angp'o, 19 Oct. 1991, 1 specimen; Kanggu, 19 Oct. 1991, 2 specimens; Wolp'o, 19 Oct. 1991, 1 specimen.

Remarks. This species is newly reported in the East Sea, Korea.

Distribution. Korea (East Sea) and Japan (Northern Honshu, Hokkaido).

Subfamily Coscinasterinae Fisher, 1923 채판불가사리아과

Genus *Distolasterias* Perrier, 1896 디스톨불가사리속

22. *Distolasterias nipon (Döderlein, 1902)* 일본불가사리

Material examined. Dongmyung-hang, 10 Aug. 1992, 1 specimen; Taep'o, 15 Oct. 1991, 6 specimens; 13 Aug. 1993, 14 specimens; Kisamun, 15 Oct. 1991, 11 specimens; Namae, 16 Oct. 1991, 1 specimen; 11 Aug. 1992, 16 specimens; Chumunjin, 16 Oct. 1991, 1 specimen; 12 Aug. 1992, 1 specimen; Okkye, 17 Oct. 1991, 11 specimens; Changho, 17 Oct. 1991, 50 specimens; Imwon, 17 Oct. 1991, 25 specimens; Chukpyon, 18 Oct. 1992, 5 specimens; Osan, 18 Oct. 1992, 2 specimens; Hup'o, 19 Oct. 1991, 3 specimens; Ch'ahyu, 19 Oct. 1992, 7 specimens; Ch'angp'o, 19 Oct. 1991, 1 specimen; Kanggu, 19 Oct. 1991, 2 specimens; Wolp'o, 19 Oct. 1991, 2 specimens; Kuryongp'o, 20 Oct. 1991, 2 specimens; 15 Dec. 1992, 2 specimens; Hajong, 20 Oct. 1991, 5 specimens; Mop'o, 20 Oct. 1991, 2 specimens; 15 Dec. 1992, 1 specimen.

Remarks. This is also a common species collected at 18 localities of total 36 localities examined in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait), Japan (Honshu, Northern Hokkaido) and Peter the Great Bay - Hong Kong.

Genus *Lethasterias* Fisher, 1923 검은불가사리속(신칭)

23. *Lethasterias fusca D'yakonov, 1931* 검은불가사리(신칭) (pl. 2)

Lethasterias fusca D'yakonov, 1931, p. 79, figs. 5-7; Hayashi, 1943, p. 209, pl. XXII, figs. 3, 4; D'yakonov, 1950, p. 104, figs. 105, 106; Imaoka *et al.*, 1991, p. 103.

Material examined. Namae, 16 Aug. 1991, 2 specimens; 16 Oct. 1991, 3 specimens; 11 Aug. 1992, 2 specimens; Chumunjin, 16 Oct. 1991, 3 specimens.

Diagnosis. Dorsal spine not black, one in number on a dorsal plate and having thick but not so heavy wreath of crossed pedicellariae. Unguiculate straight pedicellariae absent on abactinal surface. Abactinal surface black or dark gray with irregular, a little pale brownish patterns on arms.

Description. R = 10-15 mm, r = 70-130 mm, R = 7.0-9.2 r. Arm long and five in number. Abactinal plates irregularly meshed and each plate with one short, broad spine thickly wreathed with many small crossed pedicellariae. Carinal plates imbricated and arranged in a regular series. Papular area with one to ten papulae. Marginal plate four lobed, arranged in a regular series but superomarginal plates situated rather actinal side of arm. Superomarginal plates four-lobed, imbricated and each with a spine. This spine longer and stouter than the dorsolateral spines, thickly encircled by crossed pedicellariae and mostly with a shallow groove on the outer side of spine. Inferomarginal plates very similar to the superomarginals and each with two spines. These spines a little longer and stouter than superomarginal spine and with a half wreath of crossed pedicellariae on the outer side. Ventrolateral plate small, spineless and arranged in a series. Adambulacral plate with two, long and slender furrow spines without attached pedicellariae but the outer furrow spine slightly longer and stouter than the inner one. Numerous small lanceolate straight pedicellariae scattered in furrow and large unguiculate straight pedicellariae present on mouth plates and ventrolateral regions. Mouth plate provided with two oral spines and one long suboral spine. Abactinal surface entirely black or dark gray with yellowish-brown spots or irregular patterns on arms.

Remarks. This species is newly reported for the Korean fauna.

Distribution. Korea (East Sea), Japan (Sea of Japan, Northern Hokkaido), Peter the Great Bay, Tatar Strait and Aniba Bay.

24. *Lethasterias nanimensis chelifera* (Verrill, 1914) 극검은불가사리(신칭) (pl. 3)

Distolasterias chelifera: Verrill, 1914, p. 185, pl. 81, figs. 1, 1a-1b, pl. 110, figs. 1, 2.

Lethasterias nanimensis chelifera: Fisher, 1928, p. 134, pl. 60, figs. 4, 4a-4e, pl. 61, figs. 1, 1a-1g, pl. 62, figs. 1, 1a, 2, 2a, pl. 63, pl. 64, fig. 2; Hayashi, 1943, p. 212, pl. XV, fig. 6, pl. XXI, fig. 2; D'yakonov, 1950, p. 103; Hayashi, 1973, p. 103, pl. 17, fig. 1; Imaoka et al., 1991, p. 104.

Material examined. Dongmyung-hang, 22 July 1992, 1 specimen; Sokch'o, 13 Aug. 1991, 3 specimens; Taep'o, 11 Aug. 1991, 1 specimen; Changho, 13 Aug. 1992, 1 specimen; Okkye, 17 Oct. 1991, 1 specimen; Imwon, 17 Oct. 1992, 1 specimen; Ch'angp'o, 19 Oct. 1991, 1 specimen.

Diagnosis. Dorsal spine black, one on a dorsal plate and thickly wreathed with grayish white crossed pedicellariae and these encircled wreaths of crossed pedicellariae touch one another. Numerous unguiculate pedicellariae scattered all over the surface.

Description. R = 163 mm, r = 16 mm, R = 10 r. Disk very small and arm very long, tapering and five in number. Abactinal plates irregularly polygonal and interconnected with rod shaped plates but cardinal plate four lobed and imbricated in a regular series. Dorsal spine black, truncate, one on a dorsal plate and thickly surrounded with grayish white crossed pedicellariae contrasting to dark spines. These encircled wreaths of crossed pedicellariae touch one another and the groove of spine tips conspicuous. Three to five papulae in a papular area. Marginal plate four lobed, arranged in a regular series. Superomarginal plates situated low on the side of arm and each with a spine thickly wreathed

with crossed pedicellariae. This spine slightly larger than dorsolateral spines. Two inferomarginal spines on a plate, a little heavier than the superomarginals and each with a group of crossed pedicellariae on the outer side. Ventrolateral plate small and spineless. Adambulacral plate with two or three, long and truncated furrow spines. Numerous small lanceolate straight pedicellariae various in size and scattered in furrow. A large number of prominent unguiculate straight pedicellariae scattered on abactinal and lateral surface of arms and clearly visible to the naked eye. Small spatulate straight pedicellariae found in dorsal surface. Mouth plate with two oral spines of which the inner one much longer and stouter than the outer and single, long and slender suboral spine. Color brownish gray with black spines in the dorsal side and a little paler in the ventral side.

Remarks. This species is newly reported for the Korean fauna.

Distribution. Korea (East Sea), Japan (Northern Honshu, Hokkaido), Aniva Bay and North Pacific Ocean (Sachalin - Okhotsk Sea - Bering Sea - Alaska Bay).

Subfamily Pycnopodiinae Verrill, 1914 두터운불가사리아과(신칭)

Genus *Lysastrosoma* Fisher, 1922 유연불가사리속(신칭)

25. *Lysastrosoma anthosticta* Fisher, 1922 유연불가사리(신칭) (pl. 4)

Lysastrosoma anthosticta Fisher, 1922, p. 591, figs. 1, 2; 1925, p. 1, pls. 1, 2; 1928, p. 149, pl. 73, figs. 1, 1a-1j, pl. 75; Hayashi, 1943, p. 215, pl. XIV, figs. 12, 13; D'yakonov, 1950, p. 98, fig. 104.

Material examined. Dongmyung-hang, 24 July 1992, 1 specimen; 10 Aug. 1992, 1 specimen; Sokch'o, 13 Aug. 1991, 3 specimens; 22 July 1992, 1 specimen; Taep'o, 15 Oct. 1991, 1 specimen; 13 Aug. 1993, 1 specimen; Kisamun, 14 Aug. 1991, 1 specimen; Namae, 16 Oct. 1991, 4 specimens; 12 Aug. 1992, 1 specimen; Chumunjin, 16 Oct. 1991, 1 specimen; 11 Aug. 1992, 1 specimen; Okkye, 17 Oct. 1991, 1 specimen; Changho, 18 Oct. 1991, 1 specimen; 13 Aug. 1992, 1 specimen; Imwon, 18 Oct. 1991, 1 specimen; Chukpyon, 18 Oct. 1991, 2 specimens; Osan, 18 Oct. 1992, 1 specimen.

Diagnosis. Body soft and weak in having fewer disconnected dorsal plates and poorly developed marginal skeleton. Superomarginal plates alternatively spineless and inferomarginals with two spines bearing numerous crossed pedicellariae in a common sheath.

Description. $R = 160$ mm, $r = 17$ mm, $R = 9.4 r$. Arm soft, weak, and five in number. Whole body soft and flabby due to the absence of the dorsal connecting skeleton. Dorsal skeleton composed of small plates, each with a slender spine thickly surrounded with crossed pedicellariae. Numerous papulae and small, slender lanceolate straight pedicellariae scattered over the surface. Spineless superomarginal plates much smaller than the spiniferous plates. Superomarginal spines long, slender and surrounded with a thick sheath of pedicellariae except the tip of spine. Superomarginal and inferomarginal plates disconnected except in the proximal portion of arm where both plates connected by one or two small intermediate ossicles. Two, subequal and bluntly pointed inferomarginal spines covered by a thick sheath and wreathed with numerous crossed pedicellariae with a conspicuous enlarged lateral terminal tooth. Ventrolateral plates absent and one adambulacral spine without attached pedicellariae. Small straight pedicellariae present in furrow and in oral spines. Mouth plate provided with two or three oral spines and a long suboral spine. Color of body brownish purple and of spine brownish red.

Remarks. This species is newly reported for the Korean fauna.

Distribution. Korea (East Sea), Japan (Northern Honshu, Hokkaido), Poseta Bay, Tatar Strait and Aniba Bay.

Subfamily Asteriinae (Verrill, 1914) 불가사리아과

Genus *Aphelasterias* Fisher, 1923 아펠불가사리속

26. *Aphelasterias japonica* (Bell, 1881) 아펠불가사리

Material examined. Kajin, 12 Aug. 1991, 1 specimen; Ayajin, 23 July 1992, 1 specimen; Dongmyung-hang, 24 July 1992, 2 specimens; 10 Aug. 1992, 4 specimens; Sokch'o, 13 Aug. 1991, 1 specimen; Taep'o, 15 Oct. 1991, 1 specimen; 22 July 1992, 2 specimens; 13 Aug. 1993, 14 specimens; Kisamun, 11 Aug. 1992, 2 specimen; Namae, 16 Oct. 1991, 1 specimen; 12 Aug. 1992, 16 specimens; Chumunjin, 16 Oct. 1991, 1 specimen; 12 Aug. 1992, 6 specimens; Kangmun, 16 Aug. 1991, 3 specimens; Okkye, 12 Aug. 1992, 3 specimens; Changho, 13 Aug. 1992, 4 specimens; 17 Oct. 1992, 7 specimens; Imwon, 12 Aug. 1992, 1 specimen; 17 Oct. 1992, 3 specimens; Chukpyon, 18 Oct. 1992, 3 specimen; Hup'o, 18 Oct. 1992, 1 specimen; Ch'ahyu, 19 Oct. 1992, 2 specimens; Wolp'o, 19 Oct. 1991, 2 specimens; Kuryongp'o, 15 Dec. 1992, 2 specimens; Mop'o, 20 Oct. 1991, 1 specimen; 15 Dec. 1992, 1 specimen.

Distribution. Korea (East Sea, Korea Strait, Yellow Sea), Japan (Sea of Japan, Toyama Bay, Thruha and Hokkaido), Sakhalin, Tatar Strait and Aniba Bay.

27. *Aphelasterias japonica torquata* (Sladen, 1889) 꼬인아펠불가사리

Material examined. Dongmyung-hang, 10 Aug. 1992, 1 specimen; Taep'o, 13 Aug. 1993, 2 specimens; Kisamun, 16 Oct. 1991, 1 specimen; Namae, 12 Aug. 1992, 1 specimen; Chumunjin, 16 Oct. 1991, 1 specimen; 11 Aug. 1992, 2 specimens; Kangmun, 16 Aug. 1991, 1 specimen; Imwon, 18 Oct. 1991, 1 specimen; 17 Oct. 1992, 1 specimen; Chukpyon, 18 Oct. 1991, 1 specimen; Kuryongp'o, 20 Oct. 1991, 3 specimens; 15 Dec. 1992, 1 specimen; Hajong, 20 Oct. 1991, 1 specimen; Mop'o, 20 Oct. 1991, 1 specimen.

Distribution. Korea (East Sea) and Japan (Yokohama - Tsugaru Strait).

Genus *Asterias* (Linnaeus, 1758) 아르브불가사리속

28. *Asterias amurensis* Lütken, 1871 아르브불가사리

Material examined. Dongmyung-hang, 22 July 1992, 3 specimens; 10 Aug. 1992, 3 specimens; Sokch'o, 13 Aug. 1991, 2 specimens; Taep'o, 15 Oct. 1991, 5 specimens; 22 July 1992, 2 specimens; 10 Aug. 1992, 3 specimens; 13 Aug. 1993, 11 specimens; Susan, 24 July 1992, 1 specimen; Kisamun, 14 Aug. 1991, 1 specimen; 16 Oct. 1991, 2 specimen; Namae, 16 Oct. 1991, 3 specimens; Chumunjin, 14 Aug. 1991, 1 specimen; 12 Aug. 1992, 2 specimens; Kangmun, 16 Aug. 1991, 1 specimen; Okkye, 17 Oct. 1991, 1 specimen; 12 Aug. 1992, 1 specimen; Changho, 17 Oct. 1991, 1 specimen; Changho, 17 Oct. 1992, 4 specimens; Imwon, 17 Oct. 1991, 1 specimen; 13 Aug. 1992, 2 specimens; Chukpyon, 17 Oct. 1992, 5 specimens; Osan, 18 Oct. 1991, 2 specimens; 18 Oct. 1992, 3 specimens; Hup'o, 19 Oct. 1992, 3 specimens; Ch'angp'o, 19 Oct. 1991, 1 specimen; Wolp'o, 19 Oct. 1991, 4 specimens; Hajong, 20 Oct. 1991, 1 specimen; Yangp'o, 20 Oct. 1991, 1 specimen.

Remarks. This is also a common species collected at 19 localities of total 36 localities examined in the East Sea, Korea.

Distribution. Korea (East Sea, Korea Strait, Yellow Sea), Japan (Hokkaido, Honshu, Shikoku, Kyushu), Sakhalin, Tatar Strait, Aniba Bay, Kamtchaka Peninsula and Okhotsk Sea.

Genus *Evasterias* Verrill, 1914 그물불가사리속 (신칭)

29. *Evasterias troscheli alveolata* Verrill, 1914 그물불가사리 (신칭) (pl. 5)

Evasterias troscheli alveolata Verrill, 1914, p. 162, fig. 1.

Evasterias troscheli forma alveolata Fisher, 1930, p. 144, pl. 58, figs. 2, 2a-c, 7a, 7b, pl. 59, figs. 1, la, pl. 61, figs. 2, 3, pls. 62, 63, pl. 66, fig. 1; Hayashi, 1943, pl. XVI, fig. 5, pl. XX, figs. 3, 4; D'yakonov, 1950, p. 114, fig. 205.

Material examined. Chumunjin, 16 Oct. 1991, 1 specimen.

Diagnosis. Ventrolateral plates closely imbricated, arranged in four series and each with two or three spines with crossed pedicellariae on the outer side. Straight pedicellariae small, lanceolate and few in abactinal surface and crossed pedicellariae without enlarged tooth.

Description. R = 158 mm, r = 29 mm, R = 5.5 r. Body more or less rigid and disk large. Arms broad at the base and gradually tapering, five in number. Dorsal spines small, stout, flattened with finely striated tips and crowded forming a irregular network around the papular areas. These spines encircled by small crossed pedicellariae. Papular area provided with abundant papulae and minute spinelets and small, isolated crossed pedicellariae. Marginal plate four lobed and imbricated. Suferomarginal plates larger than inferomarginal plates and form the lateral rim of arm but the inferomarginals situated low on the margin of arm. Suferomarginal spines five to eight on a suferomarginal plates and more or less larger than the dorsal spines but inferomarginal spines three to five on a plate. Ventrolateral plates closely imbricated, arranged in four series and each with two or three spines with crossed pedicellariae on the outer side. These spines longer than the marginals, truncated and often slightly flattened. Adambulacral spines two in number, encircled by a group of crossed pedicellariae and large straight pedicellariae and the outer one stouter than the inner. Small lanceolated straight pedicellariae few on the dorsal surface but abundant on intermarginal and ventrolateral surface and in furrow. Mouth plate provided with two short, stout oral spines and one, long suboral spine. The inner oral spine much longer and stouter than the outer one. Color in actinal side yellowish baize but in actinal side dark pupplish bule except yellowish abactinal skeleton.

Remarks. This species is newly reported for the Korean fauna.

Distribution. Korea (East Sea), Japan (Northern Honshu, Hokkaido) and Kamtchaka Peninsula.

Distribution of species

The distribution pattern of Korean asteroids is reviewed on the basis of the numbers of species collected and collection localities, in addition to previous reports on geographical distribution. In the distribution pattern of total 29 species, *Luidia quinaria*, *Dipsacaster pretiosus*, *Astropecten polyacanthus* and *Henricia leviuscula* known to be distributed in the Korea Strait only are also confirmed to be distributed in the East Sea. As shown in the table 2, *Asterina pectinifera* is the most common species collected from 31 localities of total 36 localities and *Asterias amurenris* and *Crossaster papposus*, each from 19 localities, *Distolasterias nipon* from 18 localities, *Aphelasterias*

Table 1. List and number of Korean asteroids occurring in only one or two more regions.

Region	List of species	Number of species
East Sea	<i>Ctenodiscus crispatus</i> , <i>Leptychaster arcticus</i>	15
	<i>Leptychaster anomalus</i> , <i>Astropecten kagoshimensis</i>	
	<i>Pseudarchaster parelii</i> , <i>Henricia reniessa</i>	
	<i>Poraniopsis inflata</i> , <i>Solaster endeca</i>	
	<i>Pteraster tessellatus</i> , <i>Pteraster tessellatus</i>	
	<i>Plazaste borealis</i> , <i>Lethasterias fusca</i>	
	<i>Lethasterias nanimensis chelifera</i> , <i>Lysastrosoma anthosticttha</i> <i>Aphelasterias japonica torquata</i> , <i>Evasterias troscheli alveolata</i>	
East Sea, Korea Strait	<i>Astropecten polyacanthus</i> , <i>Henricia leviuscula</i>	6
	<i>Henricia pachyderma</i> , <i>Solaster uchidai</i>	
	<i>Crossaster paposus</i> , <i>Distolasterias nipon</i>	
East Sea, Korea Strait, Cheju Island	<i>Dipsacaster pretiosus</i> , <i>Henricia regularis</i>	3
	<i>Henricia nipponica</i>	
East Sea, Korea Strait, Yellow Sea	<i>Luidia quinaria</i> , <i>Aphelasterias japonica</i>	4
	<i>Asterias amurensis</i> , <i>Solaster dawsoni</i>	
East, Sea, Korea Strait, Cheju Island, Yellow Sea	<i>Asterina pectinifera</i>	1
Total		29

japonica from 14 localities and other species from localities less than 11 localities. When the species found distributed in the East Sea only and the species found distributed in the other regions including the East Sea are compared (table 1), 15 species (51.7 %) are found distributed in the East Sea, 6 species (20.7 %) distributed both in the East Sea and the Korea Strait, 4 species distributed in the East Sea, the Korea Strait and the Yellow Sea, 3 species distributed in the East Sea, the Korea Strait and Cheju Island, except the Yellow Sea. It has been revealed that *Asterina pectinifera* is ubiquitously distributed in all coastal areas of Korea.

As shown in table 2, the oceanic distribution of asteroids reveals that all the identified species are also found in Japan, and among them 19 species are also found in Russia. And 5 species are found distributed south to the East China Sea, 3 species distributed south to the Indian Ocean, and 5 species in the Arctic Ocean and also in the Atlantic Ocean. The distribution type of Asteroidea according to water forms determined by considering the biogeographical zones demonstrates that 16 temperate species (55.2%), 10 northern species (34.5%) and 3 southern species (10.3%) are distributed in the coastal area of the East Sea in Korea.

Table 2. Distribution of Korean asteroids collected from East Sea according to oceanic regions at oogeographical zones.

Species	Region		Ocean										Biogeographical zone		Distribution type					
	East Sea	Korea Strait	North pacific										Warm temperate	Cold temperate	Boreal	Southern	Temperate	Northern		
			Korea		Yellow sea	Japan	Russia	Bering Sea	America	East China Sea	Indo-West Pacific	Arctic							North Atlantic	Tropical
			East Sea	Korea Strait																
<i>Luidia quinaria</i>	9	+		+	+	+				+	+			+	+		+			
<i>Ctenodiscus crispatus</i>	8				+	+	+	+				+	+		+	+		+		
<i>Leptychaster arcticus</i>	1				+	+	+					+	+		+	+		+		
<i>Leptychaster anomalus</i>	2				+	+	+	+					+	+			+			
<i>Dipsacaster pretiosus</i>	2	+	+		+					+	+		+	+			+			
<i>Astropecten polyacanthus</i>	7	+			+					+	+		+	+			+			
<i>Astropecten kagoshimensis</i>	1				+								+				+			
<i>Pseudarchaster parelii</i>	6				+	+	+					+	+		+	+		+		
<i>Asterina pectinifera</i>	31	+	+	+	+	+							+	+			+			
<i>Henricia leviuscula</i>	2	+			+	+	+	+						+	+			+		
<i>Henricia reniessa</i>	1				+									+			+			
<i>Henricia regularis</i>	2	+	+		+								+				+			
<i>Henricia nipponica</i>	10	+	+		+								+				+			
<i>Henricia pachyderma</i>	2	+			+								+				+			
<i>Poraniopsis inflata</i>	2				+	+		+						+			+			
<i>Solaster endeca</i>	1				+	+	+				+	+		+	+			+		
<i>Solaster dawsoni</i>	5	+		+	+	+	+	+						+	+			+		
<i>Solaster uchidai</i>	3	+			+				+				+				+			
<i>Crossaster papposus</i>	19	+			+	+	+	+			+	+		+	+			+		
<i>Pteraster tessellatus</i>	2				+	+	+	+					+	+				+		
<i>Plazaster borealis</i>	9				+									+				+		
<i>distolasterias nippon</i>	18	+			+	+			+				+	+				+		
<i>Lethasterias fusca</i>	2				+	+			+					+				+		
<i>L. nanimensis chelifera</i>	7				+	+	+							+	+			+		
<i>Lysastrosoma anthosticta</i>	11				+	+								+				+		
<i>Aphelasterias japonica</i>	14	+		+	+	+								+				+		
<i>A. japonica torquata</i>	10				+									+				+		
<i>Asterias amurensis</i>	19	+		+	+	+								+				+		
<i>Evasterias troscheli alveolata</i>	1				+	+								+				+		
Total		14	4	5	29	19	10	7	5	3	5	5	3	10	21	10	3	16	10	

The number presented in the East Sea indicates the numbers of localities where the asteroids were collected.

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한국 동해산 해성류의 계통분류학적 연구

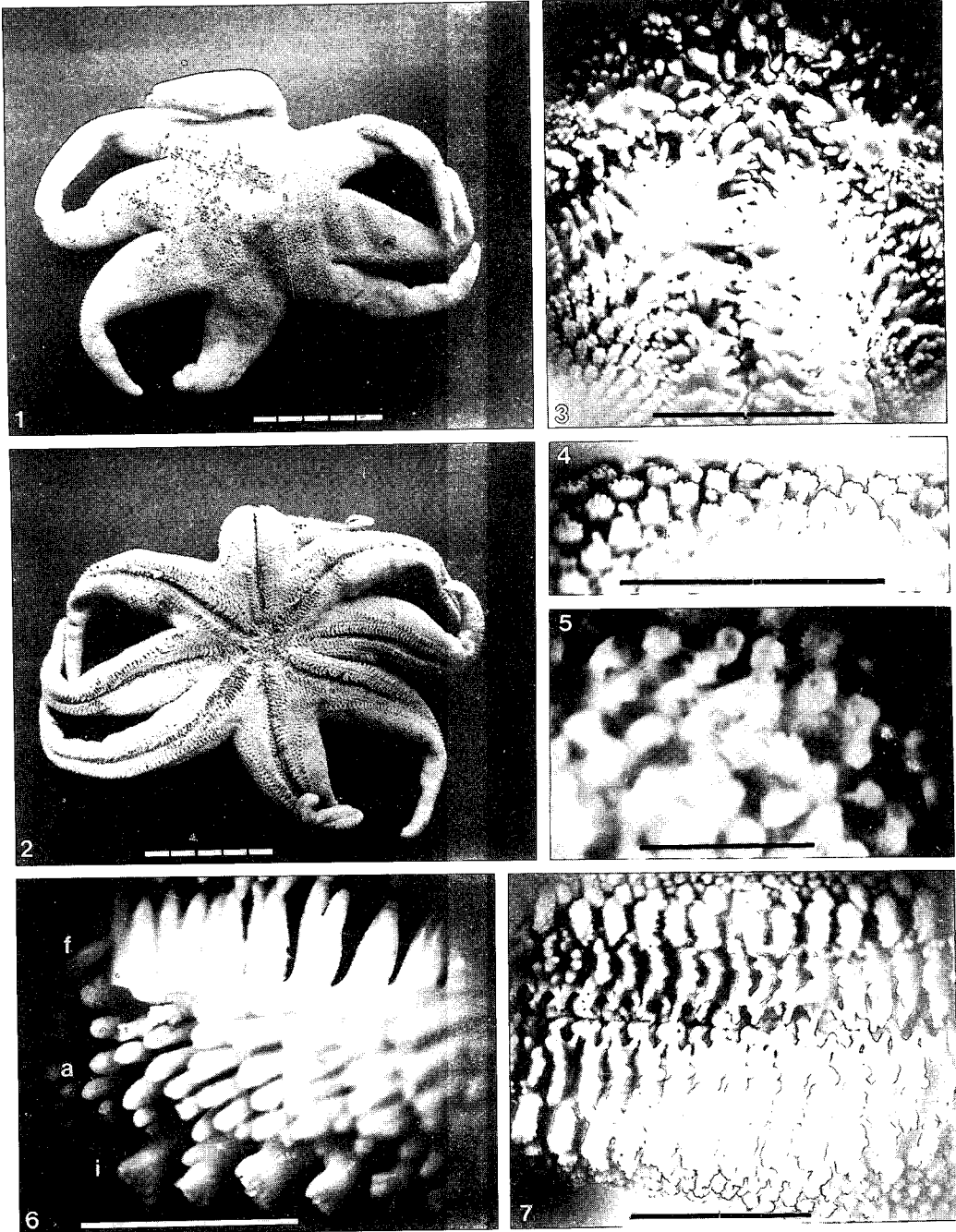
신 숙

(삼육대학교 생물학과)

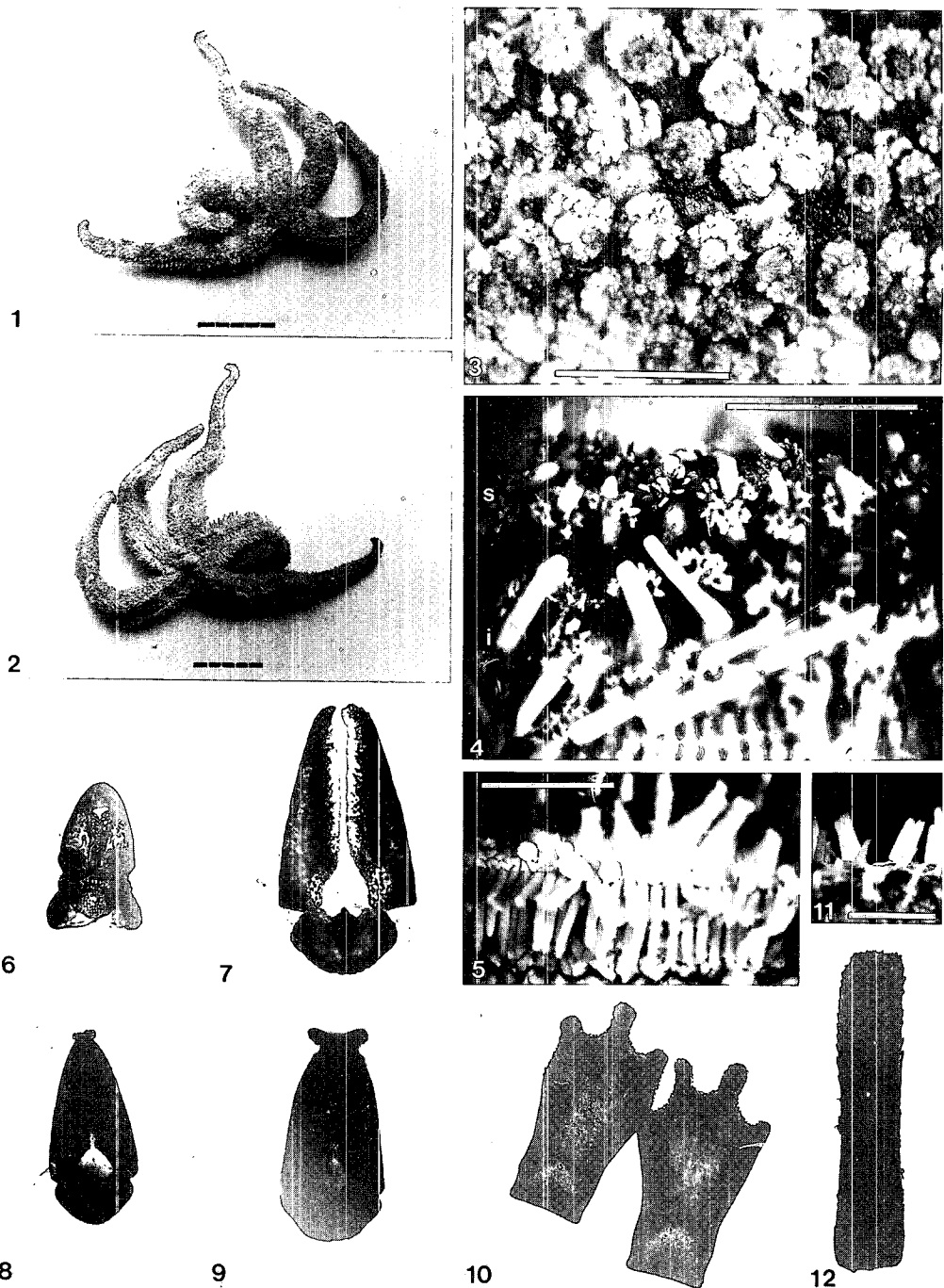
요 약

1990년 4월 부터 1993년 8월까지 우리나라의 동해 연안의 총 36개 지역에서 채집된 해성류를 동정하였다. 그 결과 5목 8과 19속 29종이 밝혀졌고, 이들 중 *Solaster endeca*, *Lethasterias fusca*, *Lethasterias nanimensis chelifera*, *Lysastrosoma anthosticta*, *Evasterias troscheli alveolata* 등 5종은 한국 미기록종이었다. *Asterina pectinifera*가 31개 지역에서 채집되어 가장 넓게 분포하는 종으로 나타났고 가장 많은 개체가 채집된 종은 *Distolasterias nipon*으로 총 820개체 중 209개체가 채집되었다. 총 29종에서 동해에만 분포하는 종은 15종이었고 동해 연안에는 온대종 16종(55.2%), 한대종 10종(34.5%), 열대종 3종(10.3%)이 분포하는 것으로 나타났다. 현재까지 우리나라 연안에 분포하는 것으로 밝혀진 해성류는 48종이 된다.

Plate I

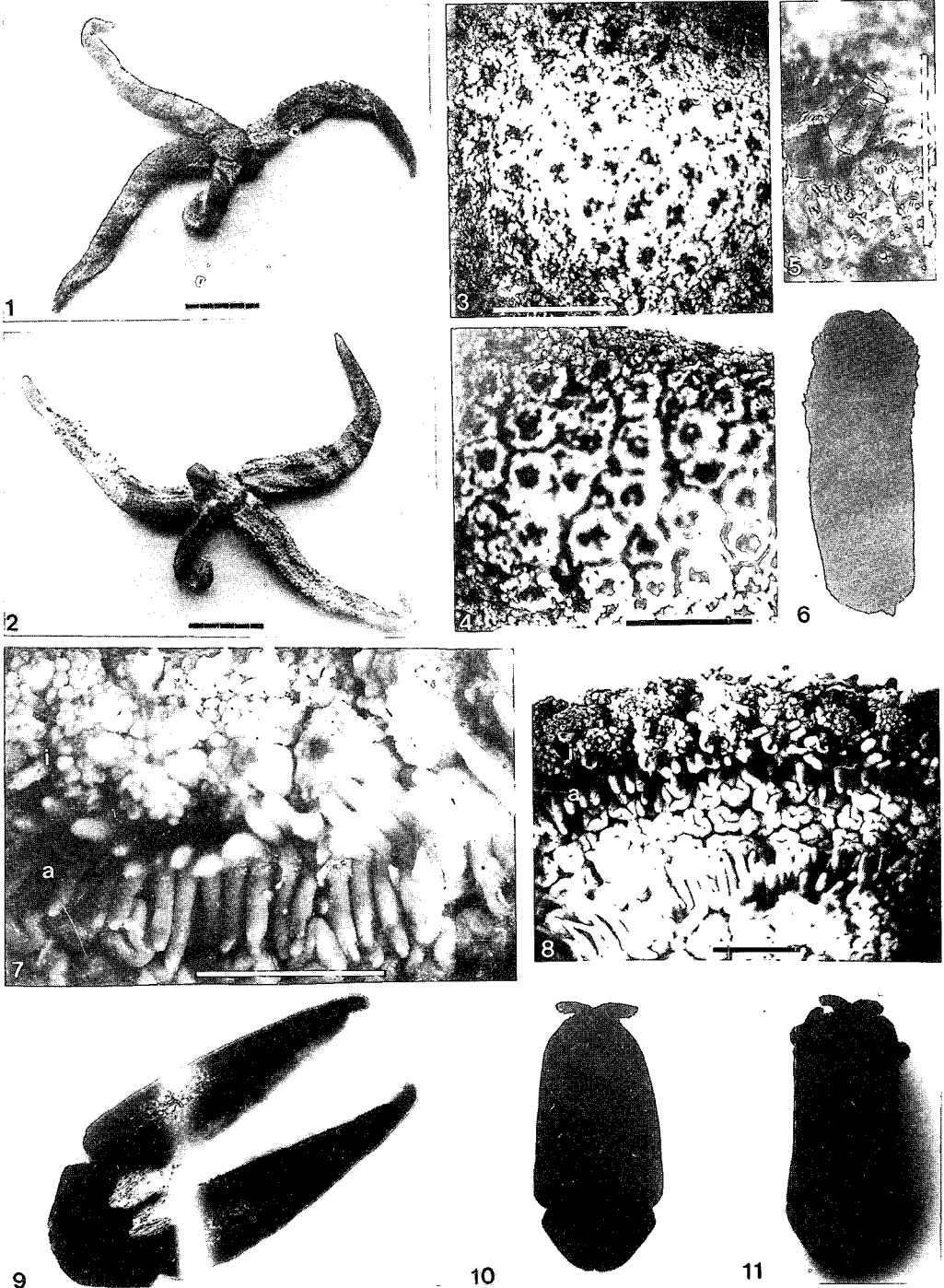


Solaster endeca (Linné, 1771): 1, abactinal side; 2, actinal side; 3, mouth part; 4, paxillae and papullae viewed from side; 5, paxillae on the disk; 6, furrow spines (f), adamburacral spines (a) and inferomarginal paxillae (i); 7, actinal side of arm. One scale measures 5 mm.



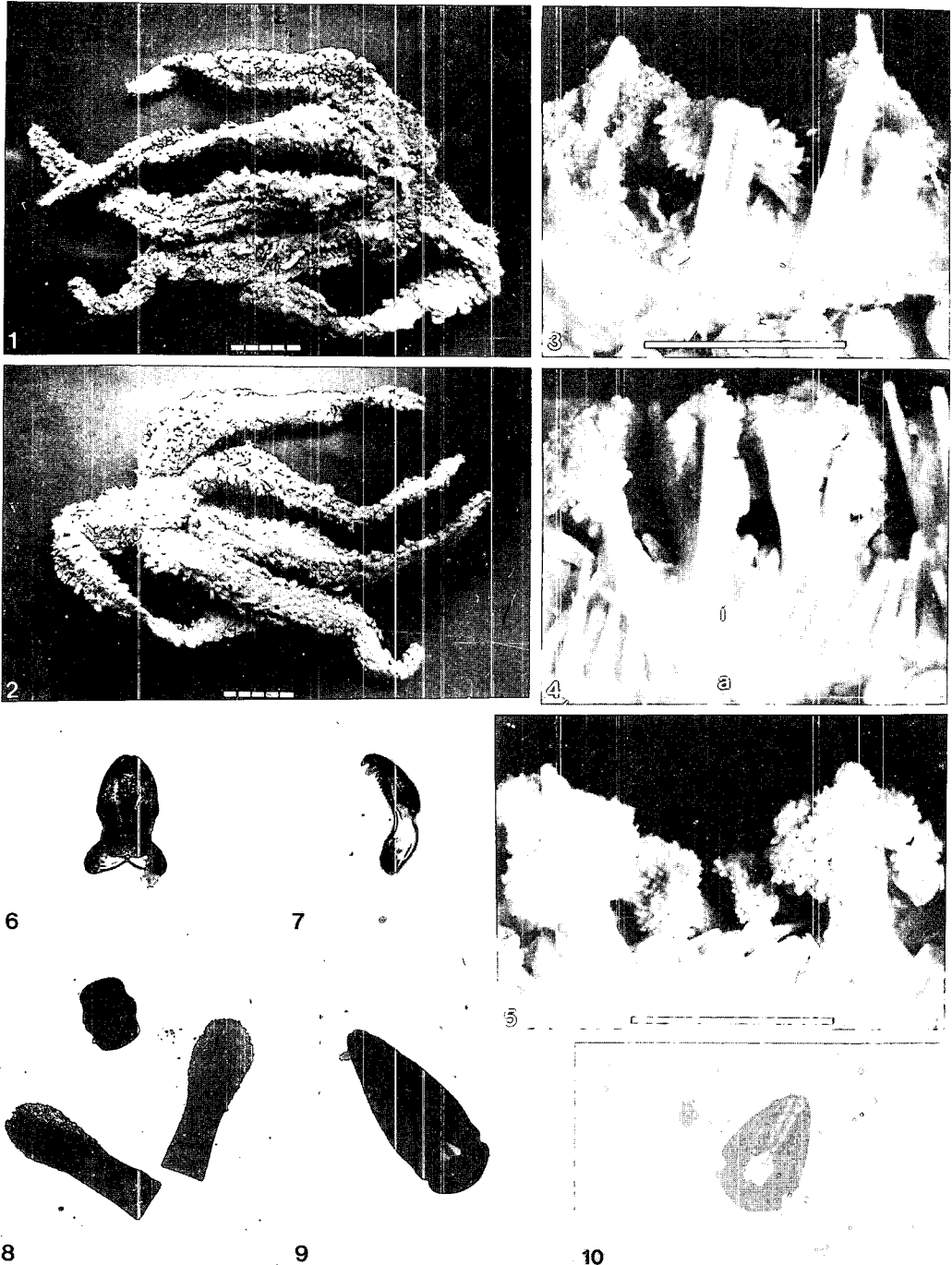
Lethasterias fusca D'yakonov, 1931: 1, abactinal side; 2, actinal side; 3, dorsal spines wreathed with crossed pedicellariae; 4, inferomarginal spines (i) with a half wreath of crossed pedicellariae on the outer side and superomarginal spines (s) wreathed with crossed pedicellariae; 5, adamburacral spines (a) and inferomarginal spines (i) 6, crossed pedicellariae; 7, straight pedicellariae; 8, 9, unguiculate straight pedicellariae; 10, valves of unguiculate straight pedicellariae; 11, 12, dorsal spines. One scale measures 5 mm.

Plate 3



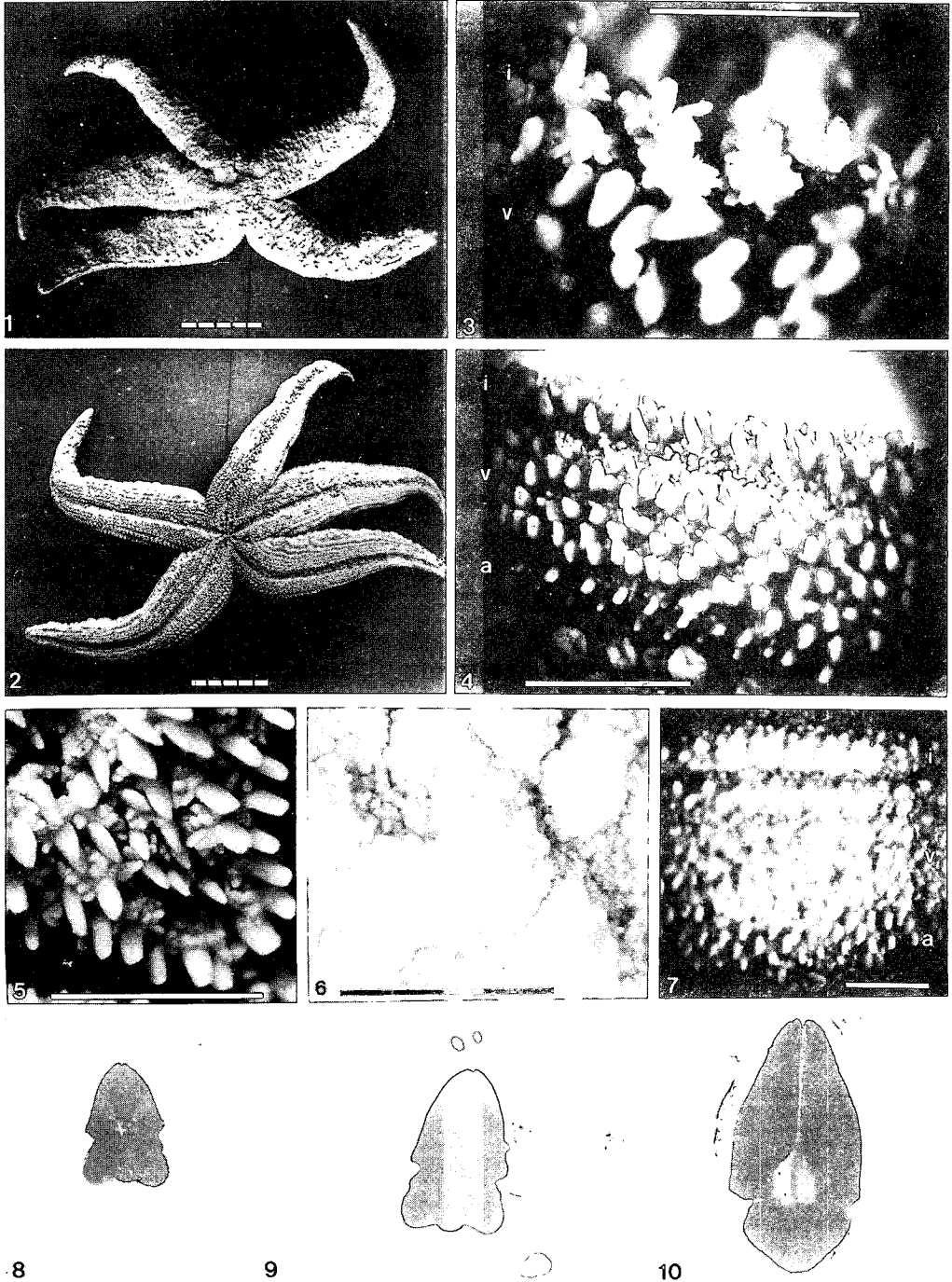
Lethasterias nanimensis chelifera (Verrill, 1914): 1, abactinal side; 2, actinal side; 3, black dorsal spines thickly wreathed with crossed pedicellariae on the disk; 4, black dorsal spines thickly wreathed with crossed pedicellariae on the arm; 5, unguiculate straight pedicellariae on the ventrolateral portion; 6, dorsal spine; 7, 8, adambulacral spines (a) and inferomarginal spines (i) wreathed with a cluster of crossed pedicellariae on the outer side; 9, lanceolate straight pedicellariae; 10, 11, unguiculate straight pedicellariae. One scale measures 5 mm.

Plate 4



Lysastrosoma anthosticta Fisher, 1922: 1, abactinal side; 2, actinal side; 3, 4, adamburacral furrow spine (a) on each adamburacral plate and inferomarginal spines (i); 5, superomarginal spines crowdedly wreathed with crossed pedicellariae; 6, crossed pedicellariae; 7, valve of crossed pedicellariae; 8, valves of lanceolate straight pedicellariae; 9, lanceolate straight pedicellariae; 10, straight pedicellariae. One scale measures 5 mm.

Plate 5



Evasterias troscheli alveolata Verrill, 1914: 1, abactinal side; 2, actinal side; 3, 4, 7, inferomarginal spines (i) wreathed with pedicellariae, truncate ventrolateral spines (v) with crossed pedicellariae on the outer side and adambulacral spine (a) with a cluster of crossed pedicellariae; 5, mouth part; 6, cylindrical dorsal spines packed on large plates; 8, 9, crossed pedicellariae; 10, straight pedicellariae. One scale measures 5 mm.