



ON SOME COLLECTIONS OF ECHINODERMATA FROM ANDHRA PRADESH AND ORISSA COASTS OF INDIA

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Accounts of faunal resources of different coastal segments are important to trace the availability and to assess the extent of distribution as well as the similarity among the fauna and the habitats. Knowing the echinoderm resources is additionally important because of their connection with the health of the environment. The studies of Ganapati and Lakshmana Rao (1962a, b), Rao and Rao (1962), Radhakrishna and Ganapati (1968) and Vijayakumar *et al.* (1991) on the Andhra Pradesh fauna and of Nagabhushanam and Rao (1969) on Orissa are mainly directed towards ecological aspects and only common species of echinoderms are included in their faunal lists. Recently Sastry (2007) compiled a list of echinoderm species reported from the Indian coast with state wise distribution in the annotation which included 85 spp. from Andhra Pradesh (assuming the echinoids *Salmaciella dussumieri* and *Lovenia elongata* might be from Andhra Pradesh though reported from 'Coromandal Coast' which includes Tamil Nadu and Andhra Pradesh coasts but not definitely known) and 52 spp. from Orissa coasts. During the recent survey of Andhra Pradesh and Orissa coasts, 40 species of echinoderms were encountered. The material included several species new to these coasts including one asteroid and one holothurian new to India and reveals extensive distribution along these coasts. These are briefly reported hereunder. Photographs of most of the species are given to facilitate identification of future local collections. All the material is present in the Zoological Collections of Marine Biology Laboratory, Andhra University, Visakhapatnam.

Phylum ECHINODERMATA
Class CRINOIDEA
Order COMATULIDA
Family HIMEROMETRIDAE

1. *Heterometra philiberti* (J. Müller, 1849)

1909. *Amphimetra mortenseni* A. H. Clark, *Proc. U. S. nat. Mus.*, **36**: 635. South Andamans: Port Blair.
1912. *Amphimetra philiberti*: A. H. Clark, *Echinoderma of the Indian Museum*, Part VII: 107, 316. Andaman Id, Port Blair.
1971. *Heterometra philiberti*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow water Indo-West Pacific echinoderms*, 8-9 (distribution) and 77 (key).
1983. *Amphimetra philiberti*: James, D. B. *Bull. cent. Mar. Res. Inst.*, **34**: 88 (Andamans)
2007. *Heterometra philiberti*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 12

Material : Andhra Pradesh: Vizianagaram District- off Santapalli Rocks, 18°03' N 83°39' E, 10 m, 20 specs.

Description : Arms 21 in number, 60-80mm long; first brachial syzygy at 3+4 and the second well beyond 9+10. Proximal pinnules smooth, not conspicuously flared or spinose; P1, P2 and P3 gradually becoming longer and stouter. IBr of two ossicles and IIBr of four ossicles with syzygy at 3+4. There is only one IIIBr series in each specimen, of two segments without a syzygy in one specimen and of four segments with syzygy at 3+4 in the other two. Cirri about 20 in number, of about 30 segments, a prominent median dorsal spine on each of the distal segments; terminal claw curved.

Remarks: In Sastry (2007: 164, *Chaetodiadema granulatum* and elsewhere) Santapalli was inadvertently mentioned as in Srikakulam District under Koehler (1927), but it is in Vizianagaram District.

Distribution : India- Andaman Islands. The species is newly recorded here from Andhra Pradesh of Indian peninsula.

Elsewhere : Bay of Bengal and East Indies.

Family MARIAMETRIDAE

2. *Lamprometra palmata* (J. Müller, 1841)

(Pl. I. Fig. 1)

1971. *Lamprometra palmata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 8-9 (distribution) and 24 (key).

2007. *Lamprometra palmata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 13

Material : Andhra Pradesh : Visakhapatnam District- off Pudimadaka, 5 m, 1.11.2008, five specs; off Pudimadaka, 5 m, 17.3.2009, two specs.

Description : Arms up to 40 in number, more than 40 mm long. Division series of only two segments, no syzygy; IIIBr series sometimes only on inner or outer side, rarely IIIBr series absent. P2 larger than P1 and P3. First brachial syzygy at 3+4 and the second at 16+17. Cirri about 30 in number with about 25 segments, dorsal side of segments smooth and rounded.

Remarks : Larger specimens were once common in the intertidal rocky habitat at Pudimadaka and Rao and Sowbhagyavathi (1972) reported several associates, particularly myzostomes from these. The two specimens collected on 17.3.2009 were on a gorgonacean and had five small specimens of the epizoic ophiothricid ophiuroid *Ophiothela danae*.

Distribution : India- Daman, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh.

Elsewhere : West coast of India and Maldives to Hawaiian and South Pacific Islands.

Family TROPIOMETRIDAE

3. *Tropiometra carinata* (Lamarck, 1816)

(Pl. I. Fig. 2)

1971. *Tropiometra carinata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 10-11 (distribution) and 25 (key).

2007. *Tropiometra carinata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 19

Material : Andhra Pradesh: Vizianagaram District- off Santapalli Rocks, 18°03' N 83°39' E, 10 m, 20 specs; Visakhapatnam District- off Pudimadaka, 5 m, 1.11.2008, 21 specs and 15 m, one spec; 25 m, 17.3.2009, seven specs.

Description : Arms 10 in number, 20-80 mm long, arm segments with a longitudinal tubercle-like thickening on dorsal side at the middle of the distal margin giving a keeled appearance; first brachial syzygy at 3+4 and the second mostly at 9+10. Pinnules erect, segments prismatic and keeled on dorsal side. IBr of two ossicles, no syzygy. Cirri 25-40 in number, of about 20-25 segments, dorsal and ventral sides smooth and rounded, no spines or ridges.

Remarks : The species is very common at the rocky habitats of Visakhapatnam coast.

Distribution : India- Andhra Pradesh and Tamil Nadu.

Elsewhere : Red Sea, SE Arabia, East coast of Africa and Madagascar to Bay of Bengal and? East Indies.

Class ASTEROIDEA

Order PAXILLOSIDA

Family LUIDIIDAE

4. *Luidia hardwicki* (Gray, 1840)

(Pl. I. Figs. 3, 4)

1971. *Luidia hardwicki*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 44 (key), 30-31 (distribution)

2007. *Luidia hardwicki*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 24

Material : Andhra Pradesh: Srikakulam District- off Barua (INS-06, Station 12, D-1, September, 2006), 30m two specs, R = 12 and 15 mm; Visakhapatnam District- Pudimadaka, 35 m, 1.11.2008, one spec; Pudimadaka, St. 3, 15 m, 17.3.2009, one spec, R = 20 mm; Guntur District- Nizampatnam Bay (Station 19/1, 12.10.2006), two specs, R/r = 37/7 and 32/7 mm; (Station 14/2, 12.10.2006), one spec, R/r = 45/8 mm in the longest arm, remaining regenerating arms 20-22 mm; (Station 19/2, 13.10.2006), 1 spec; (Station 17/1, 12.10.2006), two specs, larger specimen complete arm R = 75 mm, other arms broken; (Station 18/1, 12.10.2006), four specs, R = 11-65 mm.

Remarks: The specimens measure 12-65 mm in R; some of the specimens have only one complete arm and the others are broken or regenerating small arms.

Distribution: India- Maharashtra, Tamil Nadu and West Bengal. The species is newly recorded from Andhra Pradesh.

Elsewhere : SE Arabia, Persian Gulf, Islands of Western Indian Ocean, Bay of Bengal, East Indies, South China Sea and North Australia.

Family ASTROPECTINIDAE

5. *Astropecten euryacanthus* Lütken, 1872

(Pl. I. Figs. 5, 6)

1971. *Astropecten euryacanthus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 44 (key), 30-31 (distribution)

2007. *Astropecten euryacanthus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271: 27*

Material : Andhra Pradesh: Guntur District- Vodarevu, 9 km NE of Chirala; 20-22 Dec. 1964; N. V. Subba Rao; 24 specs.

Description : The specimens measure from about 50 mm to 80 mm in R. In the largest specimen, R/r = 80/20, width at base 19 mm, broadest after a few segments (21 mm), width of paxillar area = 11 mm. Actinal plates mostly three, two in some interradial. Superomarginal spines are absent, inferomarginals with a chisel shaped flat spine at the margin and scale like spinelets on the actinal surface.

Remarks : Clark (1989) proposed justification of suppression of the senior synonym *Asterias petalodea* Retzius, 1805 to avoid confusion arising out of application of priority. The specimens are in the National Zoological Collection of Zoological Survey of India, Kolkata and inadvertently missing in Sastry (2007).

Distribution : India- Andhra Pradesh (Krishna District), West Bengal and Nicobar Islands. This is an additional locality from Andhra Pradesh.

Elsewhere : Sri Lanka.

6. *Astropecten monacanthus* Sladen, 1883

(Pl. I. Figs. 7, 8)

1971. *Astropecten monacanthus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 46 (key), 30-31 (distribution)

2007. *Astropecten monacanthus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271: 30*

Material : Orissa: Off Chilika Lake (INS-06, Station 14, D-1; Sep. 2006), 20m, one spec.

Remarks : The specimen measures R/r = 55/15 mm; actinal plates two; interradial superomarginals without spines; distal superomarginals with very small tubercles; inferomarginals with one broad pointed spine, below the main spine, one spine one-fourth of the main one or still smaller, actinal surface covered with rounded scales.

Distribution : India : Tamil Nadu, Orissa and Andaman Islands. Earlier it was also reported from 'Coromandel Coast' which includes Tamil Nadu and part of Andhra Pradesh. Though the exact location is not clear, the record was mentioned as from Andhra Pradesh Coast in Sastry (2007)

Elsewhere : Arabian Gulf, East Africa to South China Sea and Philippine Islands and north Australia.

7. *Astropecten vappa* Müller and Troschel, 1843

(Pl. VI. Fig. 41)

1971. *Astropecten vappa*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 45 (key), 30-31 (distribution)

2007. *Astropecten vappa*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271: 31*

Material : Andhra Pradesh: Visakhapatnam District- off Pudimadaka, 10 m, 29.10.2008, one specimen, R/r = 40/9 mm, Br = 9 mm, Px = 4.5 mm, two interradial superomarginals on each side with a tubercle-like spine on the inner margin and the series on the outer margin extending up to two-thirds the length of the arm; off Pudimadaka, St. 1, 5 m, 17.3.2009, five (three, R=30-32 mm and two juvenile) specs; off Pudimadaka, St. 2, 5 m, 17.3.2009, one spec., R/r=37/12 mm; off Pudimadaka, St. 3, 15 m, 17.3.2009, one spec, R/r=42/13 mm; off Pudimadaka, St. 1, 10 m, 18.3.2009, three specs, R=36-37 mm; East Godavari District- Kakinada Bay (Station 2C-D2, 11.06.2007), one spec; R/r = 15/5 mm, superomarginal spines only on the proximal three segments, others without spines; (Station 3-D2, 11.06.2007), one spec; R/r = 34/10 mm; (Station 1-D1, 19.06.2007), one spec, R/r = 30/8 mm. **Orissa:** Off Subarnarekha river mouth (Station 3-D1, 19.6.2007), five specs, R/r = 27/7 mm;

superomarginal spines short and continuous from interradial area to tip of the arm, 2-3 plates about the middle of the arm with an inner series of spines; adambulacrals with three furrow spines, subambulacrals in two series of two and two or three spinelets; inferomarginals with one long pointed spine on the margin, one large spine of half the length of the main surrounded by two or three small spinelets; actinal surface with small rounded scale-like covering; (Station 1A-D1), 17 specs, R = 18-26 mm.

Distribution : India- Gujarat, Tamil Nadu and Andaman Islands. This is the first report of the species from Andhra Pradesh and Orissa.

Elsewhere : Sri Lanka, South China Sea, Philippine Islands and SW Australia to southern Queensland.

8. *Astropecten velitaris* von Martens, 1865

(Pl. II. Fig. 9)

1865. *Astropecten velitaris* von Marten, E. Arch. Naturgesch. 31: 360

1971. *Astropecten velitaris*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 46 (key), 30-31 (distribution)

1989. *Astropecten velitaris*: Clark, A. M. In: M. Jangoux and J. M. Lawrence (eds.), *Echinoderm Studies*, 3: 271. Taiwan (Formosa), Philippine Islands, Indonesia, Western Australia, 25-113 m.

Material : Andhra Pradesh: Srikakulam District-off Barua (INS-06, Station 10, D-1, Sep. 2006), 10 m, one spec, intact arm- R/r = 45/10 mm, four arms broken and regenerating; (INS-06, Station 11, D-1, Sep. 2006), 20m; one spec, R = 55 mm; (INS-06, Station 11, D-2, Sep. 2006), 20 m, three specs, R = 10, 43 and 47 mm; (INS-06 Station 12, D-2, Sep. 2006), 30m, 10 specs, R = 8-15 mm, only larger specs with small tubercle-like spines on interradial superomarginal plates; (INS-06, Station 12, D-1, Sep. 2006), 30 m, 10 specs, R = 7-13 mm; Visakhapatnam District- off Pudimadaka, 5 m, 1.11.2008, one spec, R/r = 35/18 mm, Br = 12 mm, Px = 6 mm, two interradial superomarginal plates on each side with a single tubercle like spine on the inner margin, inferomarginal plates with one marginal spine and one or two smaller spines below; East Godavari District- Kakinada Bay (Station 2C-D2, 11.06.2007), one spec, R/r = 60/13 mm, two interradial superomarginals with a little

prominent spines, very small spinelets on 6-7 plates beyond one-third of the arm, adambulacrals with three furrow spines, two large spinelets behind and a cluster of small spinelets in the distal area, inferomarginals with one long pointed spine at the margin, two large pointed spinelets, actinal surface covered with short pointed spinelets; (Station 2C-D2, 11.06.2007), three specs, R = 50, 60 and 62 mm, R = 4r; Guntur District- St. 10. Vodarevu, 21 m, 9.9.2008, five specimens, R = 9-16 mm; Nizampatnam Bay (Station 9/2, 11.10.2006), two specs, R = 9 and 10 mm; (Station 18/1, 12.10.2006), one spec, R = 18 mm; (Station 19/1, 12.10.2006): one spec; (Station 17/1, 12.10.2006), one spec; St. 5/1, 18 m, 9.7.2008, four specs; St. 5/2, 18 m, 9.7.2008, one spec. Orissa: Off Chilika Lake (INS-06, Station 13, D-1, Sep. 2006), 10 m, two specs; (INS-06, Station 13, D-2, Sep. 2006), 10 m, two specs, R = 13 and 25 mm; (INS-06, Station 15, D-2, Sep. 2006), 30 m; one spec.

Remarks : The specimens measure 7-62 mm in R and R = 4-4.5 r.

Distribution : India : The species newly recorded from the coasts of Andhra Pradesh and Orissa is new to India.

Elsewhere : Sri Lanka, East Indies, South China Sea and North Australia.

Order VALVATIDA

Family ASTERINIDAE

9. *Asterina lorioli* Koehler, 1910

(Pl. II. Fig. 10)

1971. *Asterina lorioli*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 38-39 (distribution) and 67 (key).

2007. *Asterina lorioli*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 44

Material : Andhra Pradesh: Visakhapatnam District- off Pudimadaka, St. 1, 10 m, 18.3.2009, one specimen.

Remarks : The specimen measures 20 mm in R and 12 mm in r, with R/r = 1.67. Abactinal armament of short and blunt granuliform spinelets. Popular pores single, confluent radially, margin of interradial areas thin, arms slightly thick.

Distribution : India- Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh.

Elsewhere : known only from India.

Family OREASTERIDAE

10. *Anthenea pentagonula* Lamarck, 1816

(Pl. II. Figs. 11, 12)

1997. *Anthenea pentagonula*: James, D. B. *J. mar. biol. Ass. India*, **38**: 134.2007. *Anthenea pentagonula*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 58

Material : Andhra Pradesh : Guntur District-Nizampatnam Bay (Station 18/1, 12.10.2006), five specs, R/r = 19/8, 20/8, 25/12, 28/13, 30/13, colour after preservation, pinkish on abactinal, and some actinal plates, others colourless; (Station 18/2, 12.10.2006), one specimen, R/r = 65/30, colour reddish when live, turned light brown on preservation; (Station 17/1, .09. 03.2007), one specimen, R/r = 13/6; St. 10. Vodarevu, 21 m, 9.9.2008, one spec, R/r = 57/23 mm.

Description : Abactinal side moderately convex, abactinal plates irregularly polygonal, closely packed, covered with uniform granulations, a single enlarged tubercle on some of the abactinal plates only in the largest specimen. Superomarginal plates large, vertically aligned but extending to abactinal side forming a side wall, covered with uniform granulation. Inferomarginal plates with a prominent flat spine on the outer lower margin. Actinal plates parallel to the adambulacrals, covered with uniform granulation and with 1-3 large bivalved pedicellariae conspicuous particularly on the plates adjacent to the adambulacrals. Adambulacral plates with 6-8 furrow spines, 2-3 subambulacrals spines and fine granulation outer to these.

Remarks : The smallest specimen from Station 17/1 with poorly developed granulation only on the abactinal side, pedicellariae not yet developed, and very small subactinal spines, appears to be a juvenile. James (1997) revised the species of the genus and gave full synonymy.

Distribution : India- Gujarat, Tamil Nadu, Orissa and Andaman Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Bay of Bengal and South China Sea.

11. *Pentaceraster affinis* (Müller and Troschel, 1842)

(Pl. II. Figs. 13, 14)

1971. *Pentaceraster affinis*: Clark, A. M. and Rowe, F. W. *E. Monograph of shallow-water Indo-West Pacific echinoderms*, 34-35 (distribution) and 56 (key).1993. *Pentaceraster affinis*: Clark, A. M. *Echinoderm Studies*, **4**: 310. Sri Lanka area, Bay of Bengal.2007. *Pentaceraster affinis*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 62

Material : Andhra Pradesh: Guntur District-Nizampatnam (St.18/1), m, 8.3.2007, one specimen.

Description : The specimen measures 95/35 mm in R/r. Abactinal surface covered with small rising granules. Primary plates each with a spine like tubercle, continuing on the carinal series of plates, smaller in the proximal half and prominent in the distal half; also a lateral series on either side of the carinals. Supero- and inferomarginals granule covered with a prominent tubercle, no intermarginal pores or plates. Adambulacals with 8-10 small spines deep in the furrow spines and two series of subambulacrals often of three and two spines. Actinal plates covered by irregular granules, some large and high.

Distribution : **India**- Andhra Pradesh and Tamil Nadu.

Elsewhere : Bay of Bengal. The species is newly recorded from Andhra Pradesh.

Order SPINULOSIDA

Family ECHINASTERIDAE

12. *Echinaster purpureus* (Gray, 1840)

(Pl. II. Figs. 15, 16)

1971. *Echinaster purpureus*: Clark, A. M. and Rowe, F. W. *E. Monograph of shallow-water Indo-west Pacific echinoderms*, **73** (key), 40-41 (distribution)2007. *Echinaster purpureus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper No. 271*: 82

Material : Andhra Pradesh: Guntur District-Nizampatnam Bay (Station 17/1, 12.10.2006), one spec, R/r = 28/6 mm, br = 6 mm.

Remarks : Cylindrical arms with bluntly rounded tips, space between the furrow spines and subambulacral spines, and a single madreporite characterize the species.

Distribution : India- Gujarat, Tamil Nadu, Orissa and Nicobar Islands. The species is new to Andhra Pradesh.

Elsewhere : Red Sea, East Africa, Islands of Western Indian Ocean, Mascarene Islands, Maldives and Bay of Bengal.

Class OPHIUROIDEA
Order OPHIURIDA
Family OPHIONEREIDAE

13. *Ophiochiton ambulator* Koehler, 1897

(Pl. III. Fig. 17)

1897. *Ophiochiton ambulator* Koehler, R. *Ann. Sci. nat. Zool.* (8) IV: 337. Goa: 72° 38' 10" E 15° 05' 03" N, 1273 m (696 fms.); Maldives, 7° 05' 45" N 75° 04' E, 1315 m (719 fms.); Bay of Bengal; Sri Lanka: Trincomale, 366-640 m (200-350 fms.); Pakistan: Coast of Baluchistan, 1628 m (890 fms.).

1899. *Ophiochiton ambulator*: Koehler, R. *Echinoderma of the Indian Museum*, Part I: 49. Off Andhra Pradesh: Godavari Delta, 494 m (270 fms.); Off Kerala: Malabar Coast, 75°36' 30" E 9°34' 57" N, 741 m (405 fms.).

2007. *Ophiochiton ambulator*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 120

Material : Andhra Pradesh : Krishna District-Divi Point (Krishna River Mouth), *Sagar Sampada* Cruise No. 225, 700 m, three specs, dd about 28 mm; *Sagar Sampada* Cruise No. 245, 750 m; two specs, dd 25 and 22 mm, arms broken; *Sagar Sampada* Cruise No. 236, 700 m, one spec, dd = 27 mm; *Sagar Sampada* Cruise No. 236, East Godavari District- Off Kakinada, 300 m, four specs, smallest spec with dd 12 mm. **Orissa**: *Sagar Sampada* Cruise No. 225, Paradeep, 700 m, one spec, dd 20 mm; *Sagar Sampada* Cruise No. 236, Paradeep, 500 m, one spec, dd 13 mm.

Distribution : India- Goa, Kerala and Andhra Pradesh. The species is new to Orissa.

Elsewhere : Indo-Pacific.

Family OPHIACTIDAE

14. *Ophiactis savignyi* (Müller and Troschel, 1842)

1971. *Ophiactis savignyi*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 103 (key), 82-83 (distribution)

2007. *Ophiactis savignyi*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 27: 132

Material : Andhra Pradesh : Vizianagaram District- off Santapalli Rocks, 18° 03' N 83° 39' E, 10 m, four juvenile specs.

Remarks : The specimens were found entangled among coils of the arm of the crinoids from the locality. The species is characterized by rugose arm spines and trilobed distal margin of the dorsal arm plates. The species is common among the sponges and algal tufts in the rocky habitats of most localities.

Distribution : India- Gujarat, Lakshadweep, Tamil Nadu, Andhra Pradesh, Orissa and Andaman & Nicobar Islands.

Elsewhere : Tropicopolitan (Tropical Atlantic and Indo-Pacific).

Family AMPHIURIDAE

15. *Amphioplus* (A.) *cyrtacanthus*

H. L. Clark, 1915

1971. *Amphioplus* (A.) *cyrtacanthus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 101 (key), 78-79 (distribution)

2007. *Amphioplus* (A.) *cyrtacanthus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Papers*, No. 271: 134

Material : Andhra Pradesh: Krishna District-Divi Point (Krishna River Mouth) (INS-06, Station 3 (D-1); four specs; (INS-06, Station 3 (D-2), four specs.

Remarks : The species is characterized by radial shields less than half the disc radius; fourth oral papilla not larger than the third; two tentacle scales similar in size and six arm spines, hooked at the tips.

Distribution : India- Gujarat and Andaman Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Philippine Islands.

16. *Amphioplus* (Lymanella) *depressus*

(Ljungman, 1867)

(Pl. III. Figs. 18, 19)

1971. *Amphioplus* (Lymanella) *depressus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 102 (key), 80-81 (distribution)

2007. *Amphioplus* (Lymanella) *depressus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 135

Material : Andhra Pradesh : Visakhapatnam District- St. 10/1. off Pudimadaka, 30 m, 31.10.2008,

one specimen, dd = 9 mm; Off Pudimadaka, St. 6, 20 m, 18.3.2009, five specs, dd = 2-9 mm; Guntur District- Nizampatnam Bay (Station 1/2, 10.10.2006), 2 specs; (Station 2/1, 10.10.2006), 3 specs; (Station 2/2, 10.10.2006), 2 specs. **Orissa:** Off Subarnarekha river mouth (Station 7, 20.6.2007), seven specs, dd = 5-6 mm, largest arm bit about 20 mm long.

Description : Radial shields twice as long as broad and less than half the disc radius; disc scales uniformly small, not large centrally; oral shield pointed orally, distally elongated and narrow, adoral shields meeting in front of the oral shield, four oral papillae, third larger than fourth, three lateral spines, pointed, smooth, dorsal arm plates broader than long, distal margin convex; ventral arm plates broader than long, two tentacle scales.

Distribution : India- Kerala, Andhra Pradesh, Orissa and Andaman Islands.

Elsewhere : Bay of Bengal, East Indies, Philippine Islands, North Australia and South Pacific Islands.

17. *Amphioplus (Lymanella) hastatus*

(Ljungman, 1867)

(Pl. III. Figs. 20, 21)

1971. *Amphioplus (Lymanella) hastatus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 80-81 (distribution) and 102 (key).

2007. *Amphioplus (Lymanella) hastatus*: Sastry, *Rec. zool. Surv. India, Occ. Paper*, No. 271: 135

Material : Andhra Pradesh : Visakhapatnam District- St. 3/2. Pudimadaka, 30 m, 8.6.2008, one specimen, dd = 3.5 mm; St. 7/1 off Pudimadaka, 40 m, 30.10.2008, one spec.

Description : Longest intact arm 7 mm long. Disc scales smooth, naked, larger centrally, primary rosette can be discerned. Radial shields twice as long as broad, about half the radius in length. Oral papillae four on each side, third one much larger than the rest. Dorsal arm plates more than twice as broad as long, distal margin straight. Ventral arm plates with distal margin notched at the centre and lateral margins concave. Lateral arm plates with three small smooth pointed spines, the middle one largest. Oral shields narrowed in front and prolonged distally; lateral shields meeting in front of the oral shield. Tentacle pores with two scales.

Remarks : The specimen from St. 7/1 (40 m) has the central disc scales distinctly larger than the other disc scales and the distal margin of the dorsal arm plates straight (fig. 20). In the one from St. 3/2 (30 m) difference in the size of central and other disc scales is discernible only on close examination but the distal margin of dorsal arm plates is straight as in the other specimen (fig.21).

Distribution : India- West Bengal and Andaman Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Persian Gulf and East coast of Africa to Bay of Bengal.

Family OPHIOTHRICIDAE

18. *Macrophiothrix longipeda* (Lamarck, 1816)

1971. *Macrophiothrix longipeda*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 114 (key), 82-83 (distribution)

2007. *Macrophiothrix longipeda*: Sastry, *Rec. zool. Surv. India, Occ. Paper*, No. 271: 142

Material : Andhra Pradesh : Visakhapatnam District- off Pudimadaka, 20 m, two young specimens; Prakasam District- St 7/1. Vodarevu, 12 m, 9.7.2008, four specs; St. 7/2. Vodarevu, 12 m, 9.7.2008, two specs; St. 8/1. Vodarevu, 14 m, 9.7.2008, two specs; St. 9/1. Vodarevu, 15 m, 9.7.2008, two specs; St. 10. Vodarevu, 21 m, 9.9.2008, two specs. **Orissa:** Off Paradeep, (INS-06, Station 18, D-2), two specs, dd = 9 and 12 mm.

Remarks : The specimens show characteristic shape of the dorsal arm plates, disc granulation etc. of the species. The specimens from Vodarevu have the dorsal arm plates fragmented.

Distribution : India : Lakshadweep, Tamil Nadu, West Bengal and Andaman Islands. The species is new to Andhra Pradesh and Orissa coasts.

Elsewhere : East coast of Africa to North Australia and South Pacific Islands.

19. *Ophiocnemis marmorata* (Lamarck, 1816)

(Pl. IV. Fig. 24)

1971. *Ophiocnemis marmorata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 106 (key), 84-85 (distribution)

2007. *Ophiocnemis marmorata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 145

Material : Andhra Pradesh: Srikakulam District-off Barua, (INS-06, Station 12, D-2), two specs, dd = 4 mm; Visakhapatnam District-off Visakhapatnam, (INS-06, Station 7, D-2), 10 m, one spec, dd = 13 mm, a.l. = 23+ mm; (INS-06, Station 9, D-1), one spec, dd = 6 mm; St. 3. Off Pudimadaka, 30 m, 29.10.2008, two specs; St. 4. Off Pudimadaka, 10 m, 30.10.2008, five specs, dd = 6-8 mm; St. 4/2 off Pudimadaka, 10 m, 30.10.2008, four specs; St. 5. Off Pudimadaka, 20 m, 30.10.2008, five specs; Off Pudimadaka, St. 6, 20 m, 18.3.2009, five specs, dd = 2-9 mm; Off Pudimadaka, 5 m, 17.3.2009, two specs, dd = 7 and 9 mm; 15 m, 17.3.2009, two specs, 3 and 4 mm; 25 m, 17.3.2009, five specs, dd = 6-9 specs; Off Pudimadaka, St 3/2, 30 m, 18.3.2009, two specs; St. 5/2, 10 m, 18.3. one spec, dd = 10 mm; Off Pudimadaka, St. 9/1, 19.3.2009, three specs (dd one of 12 mm and two of 2 mm); Off Pudimadaka, St. 9/2, 19.3.2009, five specimens (dd one of 6 mm and four of 3 mm); Guntur District-Nizampatnam Bay, (Station 1/1, 10.10.2006), one spec; (Station 1/2, 10.10.2006), one spec; (Station 2/2, 10.10.2006), one spec; (Station 17/2, 12.10.2006), one spec, dd = 14 mm; Prakasam District- St. 10. Vodarevu, 21 m, one spec.

Remarks : The specimens show extremely large radial shields and naked ventral interradial regions devoid of scales typical of the species and with disc granulation.

Distribution : India : Tamil Nadu, West Bengal and Andaman Islands. The species is newly recorded from the coast of Andhra Pradesh.

Elsewhere : East Coast of Africa, Bay of Bengal, East Indies, South China Sea, Philippine Islands and North Australia.

20. *Ophiothela danae* Verrill, 1869

(Pl. IV. Figs. 22, 23)

1971. *Ophiothela danae*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 84-85 (distribution) and 116 (key).

2007. *Ophiothela danae*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 164

Material : Andhra Pradesh : Visakhapatnam District-off Pudimadaka, 5 m, 17.3.2009, seven specs from the crinoid *Lamprometra palmata*.

Remarks : Disc diameter of the specimens very small, arms coiling vertically, disc and arm plates

with one or more granular tubercles, limits of arm plates distinct. The species usually lives as an epizoic form on gorgonaceans

Distribution : India : Maharashtra, Tamil Nadu, Orissa, Andaman Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Persian Gulf to East coast of Africa and to South Pacific Islands (excepting Australia).

21. *Ophiothrix* sp.

Material : Andhra Pradesh: Visakhapatnam District-off Visakhapatnam (INS-06, Station 8, D-2), one disc and part of an arm; Guntur District-Nizampatnam Bay (Station 18/1, 12.10.2006); one disc.

Remarks : Because of the bad condition of the arm bit, the specimens could not be identified with any species. Koehler (1897 and 1899) reported *Ophiothrix* (*O.*) *aristulata* Lyman from Coromandel Coast of Andhra Pradesh (13°45' 38" N 80°29' 37" E, 210 fathoms *i.e.* 384 m). However no species of the genus has so far been reported from shallow waters of the Andhra Pradesh coast.

Class ECHINOIDEA

Order DIADEMATOIDA

Family DIADEMATIDAE

22. *Chaetodiadema granulatum*

Mortensen, 1903

(Pl. IV. Fig. 25)

1971. *Chaetodiadema granulatum*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 152 (key), 140-141 (distribution)

2007. *Chaetodiadema granulatum*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 164

Material : Andhra Pradesh : Guntur District-off Nizampatnam Bay, 30 m, six specimens.

Remarks : The specimens measure 100-130 mm in diameter and 30-40 mm in height with D = 3-3.5H. The test is somewhat leathery.

Distribution : India : Andhra Pradesh, Orissa, West Bengal and Andaman Islands. In Sastry (2007: 164 and elsewhere) Santapalli was inadvertently mentioned as in Srikakulam District under Koehler (1927), but it is in Vizianagaram District.

Elsewhere : Red Sea, Maldive area, Bay of Bengal, East Indies, South China Sea, Philippine Islands and North Australia.

Order PHYMOSOMATOIDA

Family STOMECHINIDAE

23. *Stomopneustes variolaris* (Lamarck, 1816)

(Pl. VI. Fig. 39)

1971. *Stomopneustes variolaris*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 140-141 (distribution) and 153 (key).

2007. *Stomopneustes variolaris*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 163

Material : Andhra Pradesh : Visakhapatnam District- Visakhapatnam (Palm Beach, Shingle led, Jalari Peta, Kailasa Hill), Yarada, Pudimadaka, Bhimuniapatnam; several specimens; DRK Sastry and others.

Remarks: The species is characterized by stirodont dentition, compound diadematoid ambulacral plates and a deep sinuous groove between the two series of interambulacral plates. The spines are generally black, sometimes with pink broken, regeneratig tips. At habitats with strong wave action, it lives in bores, supposed to be made by itself. When living in bores or in deep crevices, the spines on the protected side are short and the ones on the open side are long and pointed and projecting out into the open. This appears to be a protective adaptation.

Distribution : India : Karnataka, Lakshadweep, Tamil Nadu, Andhra Pradesh, Andaman and Nicobar Islands.

Elsewhere : Indo-Pacific tropical and subtropical coasts from the African coast to New Caledonia, Samoa and the Bonin Islands (Mortensen in Sastry, 2007).

Order TEMNOPLEUROIDA

Family TEMNOPLEURIDAE

24. *Salmaciella dussumieri* (L. Agassiz, 1846)

1971. *Salmaciella dussumieri*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 155 (key), 140-141 (distribution)

2007. *Salmaciella dussumieri*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 172

Material : Andhra Pradesh: Guntur District-

Nizampatnam Bay (Station 18/1, 12.10.2006), three specs, D/H = 20/7, 20/7 and 23/8 mm.

Remarks : Test is somewhat concave on the oral side. The specimens show angular pits, primary tubercles one each aboral ambulacral plate but one in two or three ambulacral plates at the ambitus. Primary spines banded green and secondary tubercles reddish at base.

Distribution : India : Orissa and Tamil Nadu. The species is new to Andhra Pradesh. The exact location under 'Coromandel Coast' which includes parts of Tamil Nadu and Andhra Pradesh, reported by Anderson (1894 in Sastry, 2007) is not known.

Elsewhere : SE Arabia, Red Sea and East Coast of Africa to Philippine Islands and North Australia.

25. *Salmacis virgulata* (L. Agassiz, 1846)

(Pl. IV. Fig. 26)

1846. *Salmacis virgulata* Agassiz, L. In: L. Agassiz and E. Desor, *Ann. Sci. nat.* (3) 6: 359.

1971. *Salmacis virgulata*: Clark, A. M. Clark and Rowe, *Monograph of shallow-water Indo-west Pacific echinoderms*, 156 (key), 140-141 (distribution)

2007. *Salmacis virgulata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 174

Material : Andhra Pradsh : Guntur District-Nizampatnam Bay (St.17/1, March 2007), four specs; (St. 9/2, October 2007), one spec.

Remarks : The specimens measure D/H = 50/25 mm. Test with angular pores, primary tubercles crenulate. Aboral and ambital ambulacral plates each with a primary tubercle. The spines are characteristically violet in colour, not banded.

Distribution : India : Lakshadweep and Tamil Nadu. The species is newly recorded from Andhra Pradesh.

Elsewhere : Bay of Bengal, East Indies, Philippine Islands and South China Sea.

26. *Temnopleurus toreumaticus* (Leske, 1778)

(Pl. IV. Fig. 27)

1971. *Temnopleurus toreumaticus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 154 (key), 142-143 (distribution)

2007. *Temnopleurus toreumaticus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 176

Material : Andhra Pradesh : Visakhapatnam District- off Pudimadaka, 25 m, 19.3.09, two dead tests, D = 14 and 18 mm; Guntur District- Nizampatnam Bay (Station 1/1, 10.10.2006), seven specs; (Station 1/2, 10.10.2006), four specs; (Station 2/1, 10.10.2006), 10 specs; (Station 2/2, 10.10.2006), six specs; Nellore District- St. 6/1 off Krishnapatnam, 12 m, 7.7.2008, one spec., D/H = 12/8 mm. **Orissa:** Off Subarnarekha river mouth- Station 1A, D-2, 31 specs; Station 1B, D-1, 125 specs; Station 1B, D-2, 60 specs; Station 1C, D-1, 195 specs; Station 1C, D-2, 255 specs; Station 2C, D-1, three specs; Station 2C, D-2, three specs; Station 6, D-2, 20 specs; Station 7, D-1, 55 specs; Station 7, D-2, 26 specs, D = 12-22 mm.

Remarks : The specimens have large angular pits and crenulate tubercles on the test and pore pairs are in arcs of three. Spines are banded with rusty red. The young ones occur in large aggregations in the subtidal depths, particularly around the river mouths.

Distribution : India : Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Andaman Islands.

Elsewhere : Persian Gulf and East Coast of Africa to Hawaiian Islands.

Order ECHINOIDA

Family ECHINOMETRIDAE

27. *Echinometra mathaei*. (H. M. de Blainville, 1825)

(Pl. VI. Fig. 40)

1971. *Echinometra mathaei*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 142-143 (distribution) and 157 (key).

2007. *Echinometra mathaei*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 181

Material : Andhra Pradesh: Visakhapatnam District- Visakhapatnam (Shingle Beach); three specimens. L = 52-64 mm.

Remarks : In the specimens collected long back in early seventies, the spines were olive green or white but turned dark green on preservation in formalin.

Distribution : India- Lakshdweep, Tamil Nadu, Andhra Pradesh, Andaman and Nicobar Islands.

Elsewhere : Indo-west Pacific.

Order CLYPEASTEROIDA

Family CLYPEASTERIDAE

28. *Clypeaster humilis* (Leske, 1778)

(Pl. V. Fig. 28)

1922. *Clypeaster humilis*: Koehler, R. *Echinoderma of the Indian Museum*, part IX: 51. No specimen of *Investigator* collection from Indian coast was available to Koehler, hence a specimen from Red Sea was described. This makes one doubt the identity of specimens reported by Anderson, 1894 (*vide supra*).

1971. *Clypeaster humilis*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 161 (key), 144-145 (distribution)

2007. *Clypeaster humilis*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 186 [non: Anderson, 1894. probably *Clypeaster reticulatus*]

Material : Andhra Pradesh : Guntur District, Nizampatnam Bay (Station 18/1, 12.10.2006), one spec; anterior radius = 40 mm, breadth = 70 mm, posterior region broken.

Remarks : In view of the non-availability of any specimens of the species to Koehler, identity of specimens reported by Anderson is doubtful. The exact locality of 'Coromandel Coast' is also not known.

Distribution : India : Kerala and Tamil Nadu. The species is newly recorded from Andhra Pradesh.

Elsewhere : Persian Gulf and East Coast of Africa to South Pacific Islands.

29. *Clypeaster rarispinus* de Meijere, 1903

(Pl. V. Figs. 29, 30)

1971. *Clypeaster rarispinus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 160 (key), 144-145 (distribution)

2007. *Clypeaster rarispinus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 187

Material : Andhra Pradesh : Srikakulam District- off Barua (INS-06, Station 12, D-1), 30 m, one spec, l = 44 mm; Visakhapatnam District- Off Visakhapatnam (INS- 06, Station 9, D-1), five specs; l = 20-38 mm; (INS- 06, Station 9, D-2), four specs, l x b = 23x20, 25x24, 40x40, and 45x40 mm; off Pudimadaka, St. 10/1, 30 m, 19.3.2009, two specs,

l/b = 20/20 and 23/22 mm; Krishna District- Divi Point, 30 m (Station 3, D-2), one spec; Guntur District- Nizampatnam Bay (Station 18/1, 12.10.2006), 18 specs; (Station 2/1, 10.10.2006), two specs, l = 18 and 22 mm, as long as or longer than broad; (Station 19/2, 13.10.2006), one spec, l x b = 35x32 mm; (Station 15/2, 12.10.2006), four specs; l x b in the largest = 45 x 40 mm.

Distribution : India- Gujarat, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal.

Elsewhere : SE Arabia and East Coast of Africa to East Indies.

Family LAGANIDAE

30. *Laganum decagonale* (de Blainville, 1827)

(Pl. V. Figs. 31, 32)

1971. *Laganum decagonale*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 144-145 (distribution) and 162 (key).

2007. *Laganum decagonale*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 191

Material : Andhra Pradesh : Visakhapatnam District- St. 7/1. off Pudimadaka, 40 m, 30.10.2008, four dead tests of 14-20 mm diameter; off Pudimadaka, 25 m, 17.3.2009, one dead test, l/b = 22/20mm; off Pudimadaka, 35 m, 17.3.2009, five dead tests; off Pudimadaka, St. 10/1, 30 m, 19.3.2009, one dead test.

Description : Test ten sided, appearing almost round, tests as long as broad. Five genital ores and madreporic pores in a sinuous slit. Periproct nearer to posterior margin

Distribution : India- Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Andaman Islands.

Elsewhere : Arabian Sea to South China Sea, Philippine Islands and North Australia.

Family ASTRICLYPEIDAE

31. *Echinodiscus auritus* Leske, 1778

(Pl. V. Fig. 33)

1971. *Echinodiscus auritus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 162 (key), 144-145 (distribution)

2007. *Echinodiscus auritus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 198

Material : Andhra Pradesh : Srikakulam District- off Barua (INS-06, Station 11, D-1), 20 m, one spec; l = 87 mm, as long as wide; (INS-06, Station 11 (D-2); 20 m, one spec; l = 97 mm; (INS-06, Station 12, D-1), five specs; (INS-06, Station 12, D-2), 30 m, one spec, l = 84 mm, as long as wide; Guntur District- Nizampatnam Bay (Station 17/1, 12.10.2006), five specs; l = 95-120 mm, lunules about 35 mm long. Orissa: Off Chilika Lake (INS-06, Station 14, D-1), 20 m, nine specs; l = 27-48 mm; (INS-06, Station 14, D-2), 20 m, seven specs, l = 22-32 mm, slightly broader than long.

Distribution : India : Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Andaman Islands.

Elsewhere : Persian Gulf and East Coast of India to Philippine Islands.

Order CASSIDULOIDA

Family ECHINOLAPADIDAE

32. *Echinolampas ovata* Leske, 1778

(Pl. V. Figs. 34, 35)

1971. *Echinolampas ovata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 163 (key), 144-145 (distribution)

2007. *Echinolampas ovata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 201

Material : Orissa : Off Chilika Lake (INS-06, Station 14, D-1), 20 m, one spec; l = 82 mm; (INS-06, Station 14, D-2), 20 m, four specs; l x b x h = 17 x 15 x 12, 51 x 47 x 30, 56 x 49 x 34, and 56x50x32 mm.

Remarks : The species is common in the Gulf of Mannar of Tamil Nadu coast

Distribution : India : Lakshadweep, Tamil Nadu and Orissa.

Elsewhere : SE Arabia, Red Sea, Islands of West Indian Ocean, Mascarene Islands, Bay of Bengal, East Indies and North Australia,

Order SPATANGOIDA

Family BRISSIDAE

33. *Brissopsis luzonica* (Gray, 1851)

(Pl. V. Fig. 36)

1971. *Brissopsis luzonica*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 165 (key), 146-147 (distribution)

2007. *Brissopsis luzonica*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 205

Material : Andhra Pradesh: Visakhapatnam District- off Pudimadaka, St. 1, 10 m, 18.3.2009, one specimen, l = 35 mm, b = 25 mm, anterior height = 10 mm, posterior height = 20 mm; Guntur District- Nizampatnam Bay (Station 15/2, 12.10.2006), two specs; (Station 19/2, 12.10.2006), one spec; l = 26 mm, b = 20 mm, posterior h = 10 mm.

Remarks : Along the coast of Andhra Pradesh, the species was earlier reported from RIMS Investigator Sta. 98. off Santapalli of Vizianagaram District.

Distribution : India- Kerala, Tamil Nadu, Andhra Pradesh, Orissa and Andaman Islands.

Elsewhere : Red Sea, East Cost of Africa to Hawaiian Islands.

Family SPATANGIDAE

34. *Nacospatangus (Pseudomaretia) alta* (A. Agassiz, 1863)

(Pl. VI. Figs. 37, 38)

1971. *Pseudomaretia alta*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 165 (key), 146-147 (distribution)

2007. *Nacospatangus (Pseudomaretia) alta*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 210

Material : Andhra Pradesh: Srikakulam District-off Barua (INS-06, Station 12, D-1), 30 m, five specs, primary spines (2+1); (INS-06, Station 12, D-2), 30 m, five specs, l x b x h = 26x19x10 mm, sternum posteriorly strongly carinate, raised, only single series of primary tubercles in the posterior lateral interambulacra; Guntur District- Nizampatnam Bay (Station 9/2, 11.10.2006), one spec; (Station 18/1, 12.10.2006), one spec, primary spines only two in a single row in lower area of posterior lateral interambs; (Station 17/1, 12.10.2006), two specs, l x b x h. = 30x22x9 and 33x24x12 m; St. 5/1, 18 m, 9.7.2008, one spec; St. 5/2, 18 m, 9.7.2008, five specs. **Orissa**: Off Chilika Lake (INS-06, Station 14, D-2), 20 m, five specs; l x b x h = 34x25x12 mm, others 12-13 mm in length, space between pore series of posterior ambs raised, appearing carinate, highest at the apical system only subanal fasciole present, no inner or peripetalous fasciole; primary spines limited to the two posterior lateral interambs, close to the ambitus, number varying from three to 6 in

two to three rows; labrum to ½ to end on the 2nd plate; outer series of anterior lateral petals developed only in the distal half; (INS-06, Station 14, D-1), 20 m, five specs, largest 32 mm long, six primary spines (3+2+1) in the right and five (3+2) in the left anterior lateral interambs.

Distribution : India : Karnataka, Tamil Nadu, Andhra Pradesh, Orissa and Andaman Islands.

Elsewhere : Western Indian Ocean to Philippine Islands and North Australia.

Family LOVENIIDAE

35. *Lovenia elongata* (Gray, 1845)

1971. *Lovenia elongata*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 164 (key), 146-147 (distribution)

2007. *Lovenia elongata*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 211

Material : Andhra Pradesh : Guntur District- Nizampatnam Bay (Station 17/1, 12.10.2006), one spec, l x b x h = 38 x 30 x 14 mm, highest at posterior interambulacrum, flat and low anterior to apical system.

Distribution : India : Tamil Nadu and Andaman Islands. The exact location on 'Coromandel Coast' which includes parts of Andhra Pradesh and Tamil Nadu coasts, reported by Anderson (1894 in Sastry, 2007) being not known, this is the first report of the species from Andhra Pradesh.

Elsewhere : Persian Gulf and East Coast of Africa to Philippine Islands and North Australia.

Class HOLOTHUROIDEA

Order DENDROCHIROTIDA

Family CUCUMARIIDAE

36. *Havelockia versicolor* (Semper, 1868)

1971. *Havelockia versicolor*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 180-181 (distribution).

2007. *Havelockia versicolor*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 248

Material : Andhra Pradesh : Visakhapatnam coast, K. A. Sai (the material was already mentioned in Sastry, 2007).

Distribution : India : Tamil Nadu, Andhra Pradesh and Andaman Islands.

Elsewhere : Bay of Bengal, East Indies, Philippine Islands and North Australia.

37. *Leptopentacta javanicus* (Sluiter, 1880)

(Pl. fig. 38)

1971. *Leptopentacta javanicus*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 180-181 (distribution).

2007. *Leptopentacta javanicus*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 250

Material : Andhra Pradesh : Visakhapatnam District- Visakhapatnam, 20 m, one spec; Visakhapatnam, 30 m, one spec; Pudimadaka, St.2, 20 m, 8.6.2008, eight specs; St. 4, 40 m, 8.6.2008, one spec; off Pudimadaka, St. 4/1, 40 m, 18.3.2009, two specs; St. 4/2, 40 m, 18.3.2009, one spec; St. 10/1, 30 m, 19.3.2009, one spec; Orissa: Off Chika Lake, 10 m, one spec; Off Chika Lake, 30 m, one spec.

Distribution : India- Kerala, Tamil Nadu and Andhra Pradesh. Newly recorded from Orissa coast. The species is recently collected from the coast of Karnataka also (unpublished)

Elsewhere : SE Arabia, Maldives, Bay of Bengal and East Indies.

Order APODIDA

Family SYNAPTIDAE

38. *Protankyra inflexa* Koehler and Vaney, 1905

1905. *Protankyra inflexa* Koehler, R. and Vaney, C. *Echinoderma of the Indian Museum*, part III: 109. Bay of Bengal, 750 m (410 fms), 2 specs.

Material : Andhra Pradesh : Krishna District- Divi Point, 853 m, three specs; Divi Point, 452 m, one spec; West Godavari District- Kakinada, 202 m, 83 specs; Kakinada, 454 m, five specs.

Distribution : India : Newly recorded from Andhra Pradesh and also new to Indian fauna. The types are from Bay of Bengal, but without exact locality. This is the first report with exact locality since its discovery.

39. *Protankyra similis* (Semper, 1868)

1971. *Protankyra similis* (Semper): Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-West Pacific echinoderms*, 186-187 (distribution).

2007. *Protankyra similes* (sic!): Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 260

Material : Andhra Pradesh : Kakinada (Mouth of Godavari River), Dipti. (included in Sastry, 2007)

Distribution : India : Andhra Pradesh.

Elsewhere : Bay of Bengal, Philippine Islands and North Australia.

Order MOLPADIIDA

Family CAUDINIDAE

40. *Acaudina molpadioides* (Semper, 1868)

1971. *Acaudina molpadioides*: Clark, A. M. and Rowe, F. W. E. *Monograph of shallow-water Indo-west Pacific echinoderms*, 184-185 (distribution)

2007. *Acaudina molpadioides*: Sastry, D. R. K. *Rec. zool. Surv. India, Occ. Paper*, No. 271: 267

Material : Andhra Pradesh : Kakinada (Mouth of Godavari River), Dipti.

Distribution : India : Gujarat, Tamil Nadu, Andhra Pradesh, Orissa, West Bengal and Andaman and Nicobar Islands. The species is newly recorded from Andhra Pradesh.

Elsewhere : Bay of Bengal, East Indies, Philippines and South China Sea.

SUMMARY

The echinoderm collections from Andhra Pradesh and Orissa coasts consisted of three species of Crinoidea, nine species each of Asteroidea and Ophiuroidea, 14 species of Echinoidea and five species of Holothuroidea, totaling to 40 species. Of these the asteroid *A. velitaris* and the holothuroid *Protankyra inflexa* encountered first since its discovery are new to Indian coast. The material included one species of crinoid, five species of asteroids, six species of ophiuroids, four species of echinoids and one species of holothurians new to Andhra Pradesh. Further, the asteroids *Astropecten vappa* and *A. velitaris* and the ophiuroid *Macrophiothrix longipeda* are new to Andhra Pradesh as well as to Orissa. The deep water ophiuroid *Ophiochiton ambulator* and the holothurian *Leptopentacta javanicus* are also new to Orissa. All the echinoderms consisting of 100 species from Andhra Pradesh and 57 species from Orissa, including the present additions, are listed.

ACKNOWLEDGEMENTS

We are grateful to the Ministry of Earth Sciences (formerly Department of Ocean Development), Government of India, New Delhi for financial

support. The present work was carried out at the Marine Biology Laboratory, Andhra University, Visakhapatnam. Dr D. B. James kindly identified the material of *Protankyra inflexa* while Shri S. K. Mukherjee identified most of the other holothurian

material. We are grateful to them for their help. We are grateful to the Director, ZSI, Dr. J. G. Pattanayak and Dr. Ch. Satyanarayana (Assistant Zoologists) of Zoological Survey of India, Kolkata for several courtesies.

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APPENDIX-I

Classified list of echinoderms of Andhra Pradesh coast		
(*spp. new to Andhra Pradesh, **spp. new to India, # deepwater spp.)		
Phylum ECHINODERMATA		
Class CRINOIDEA		
Order COMATULIDA		
Family HIMEROMETRIDAE	1.	<i>Heterometra philiberti</i> (J. Müller)*
	2.	<i>Heterometra reynaudi</i> (J. Müller)
Family MARIAMETRIDAE	3.	<i>Lamprometra palmata</i> (J. Müller)
Family COLOBOMETRIDAE	4.	<i>Oligometra serripinna</i> (P. H. Carpenter)
Family TROPIOMETRIDAE	5.	<i>Tropiometra carinata</i> (Lamarck)
Class ASTEROIDEA		
Order PAXILLOSIDA		
Family LUIDIIDAE	6.	<i>Luidia (Luidia) hardwicki</i> (Gray)*
	7.	<i>Luidia (Luidia) denudata</i> Koehler#
Family ASTROPECTINIDAE	8.	<i>Astropecten bengalensis</i> Döderlein
	9.	<i>Astropecten euryacanthus</i> Lütken
	10.	<i>Astropecten hemprichi</i> Müller & Troschel
	11.	<i>Astropecten indicus</i> Döderlein
	12.	<i>Astropecten monacanthus</i> Sladen
	13.	<i>Astropecten vappa</i> Müller & Troschel *
	14.	<i>Astropecten velitaris</i> v. Martens**
	15.	<i>Craspidaster hesperus</i> (Müller & Troschel)
Order VALVATIDA		
Family ASTERINIDAE	16.	<i>Asterina coronata</i> v. Martens
	17.	<i>Asterina lorioli</i> Koehler
Family GONIASTERIDAE	18.	<i>Plinthaster investigatoris</i> (Alcock)#
	19.	<i>Pseudarchaster mozaicus</i> Wood-Mason and Alcock #
	20.	<i>Stellaster childreni</i> Gray
Family OREASTERIDAE	21.	<i>Anthenea pentagonula</i> Lamarck*
	22.	<i>Goniodiscaster forficulatus</i> (Perrier)
Order SPINULOSIDA		
Family ECHINASTERIDAE	23.	<i>Echinaster purpureus</i> (Gray)*
Order FORCIPULATIDA		
Family ZOROASTERIDAE	24.	<i>Zoroaster alfredi</i> Alcock #
	25.	<i>Zoroaster barathri</i> Alcock #

Class OPHIUROIDEA		
Order PHRYNOPHIURIDA		
Family EURYALIDAE	26.	<i>Asteromorpha flosculus</i> (Alcock)
Order OPHIURIDA		
Family OPHIURIDAE		
Subfamily OPHIOLEPIDINAE	27.	<i>Ophiomusium fimbriatum</i> Koehler #
Subfamily OPHIURINAE	28.	<i>Ophiomastus tumidus</i> Koehler#
	29.	<i>Ophiopyrgus alcocki</i> Koehler #
	30.	<i>Ophiura kinbergi</i> (Ljungman)
Family OPHIONEREIDAE	31.	<i>Ophiochiton ambulator</i> Koehler #
	32.	<i>Ophionereis dubia</i> (Müller and Troschel)
Family OPHIODERMATIDAE	33.	<i>Bathypectinura heros</i> (Lyman)#
Family OPHIACANTHIDAE	34.	<i>Ophiacantha vestita</i> Koehler#
Family OPHIACTIDAE	35.	<i>Ophiactis maculosa</i> v. Martens
	36.	<i>Ophiactis modesta</i> Brock
	37.	<i>Ophiactis savignyi</i> (Müller & Troschel)
Family AMPHIURIDAE	38.	<i>Amphiodia caullery</i> (Koehler)#
	39.	<i>Amphioplus</i> (A.) <i>cyrtacanthus</i> H. L. Clark*
	40.	<i>Amphioplus</i> (<i>Lymanella</i>) <i>andreae</i> (Lütken)
	41.	<i>Amphioplus</i> (<i>Lymanella</i>) <i>depressus</i> (Ljungman)
	42.	<i>Amphioplus</i> (<i>Lymanella</i>) <i>hastatus</i> (Ljungman)*
	43.	<i>Ophiocentrus verticillatus</i> (Döderlein)
Family OPHIOTHRICIDAE	44.	<i>Macrophiothrix aspidota</i> (Müller and Troschel)
	45.	<i>Macrophiothrix longipeda</i> (Lamarck)*
	46.	<i>Ophiocnemis marmorata</i> (Lamarck)*
	47.	<i>Ophiogymna pellicula</i> (Duncan)
	48.	<i>Ophiothela danae</i> Verrill*
	49.	<i>Ophiothrix</i> (<i>Ophiothrix</i>) <i>aristulata</i> Lyman#
	50.	<i>Ophiothrix</i> sp.* (shallowater sp.)
Class ECHINOIDEA		
Order CIDAROIDA		
Family CIDARIIDAE	51.	<i>Prionocidaris baculosa</i> (Lamarck)
Order ECHINOTHURIOIDA	52.	<i>Phormosoma bursarium</i> A. Agassiz #
Family ECHINOTHURIIDAE		
Order DIADEMATOIDA		
Family DIADEMATIDAE	53.	<i>Chaetodiadema granulatum</i> Mortensen

	54.	<i>Echinothrix calamaris</i> (Pallas)
Order PHYMOSOMATOIDA		
Family STOMECHINIDAE	55.	<i>Stomopneustes variolaris</i> (Lamarck)
Order TEMNOPLEUROIDA		
Family TEMNOPLEURIDAE	56.	<i>Salmaciella dussumieri</i> (L. Agassiz)*
	57.	<i>Salmacis bicolor</i> (L. Agassiz)
	58.	<i>Salmacis virgulata</i> L. Agassiz*
	59.	<i>Temnopleurus toreumaticus</i> (Leske)
Family TOXOPNEUSTIDAE	60.	<i>Tripneustes gratilla</i> (Linnaeus)
Order ECHINOIDA		
Family ECHINOMETRIDAE	61.	<i>Echinometra mathaei</i> (de Blainville)
Order CLYPESTEROIDA		
Family CLYPEASTERIDAE	62.	<i>Clypeaster annandalei</i> Koehler
	63.	<i>Clypeaster humilis</i> (Leske)*
	64.	<i>Clypeaster rarispinus</i> de Maijere
Family FIBULARIIDAE	65.	<i>Fibularia volva</i> L. Agassiz
Family LAGANIDAE	66.	<i>Laganum decagonale</i> (de Blainville)
Family ASTRICLYPEIDAE	67.	<i>Echinodiscus auritus</i> Leske
	68.	<i>Echinodiscus bisperforatus</i> Leske
Order CASSIDULOIDA		
Family ECHINOLAMPADIDAE	69.	<i>Echinolampas castanea</i> Alcock #
Order SPATANGOIDA		
Family HEMIASTERIDAE	70.	<i>Hemiaster vanus</i> Koehler #
Family SCHIZASTERIDAE	71.	<i>Schizaster (Paraster) gibberulus</i> (Koehler)
Family BRISSIDAE	72.	<i>Brissopsis luzonica</i> (Gray)
	73.	<i>Brissopsis oldhami</i> Alcock #
	74.	<i>Metalia sternalis</i> (Lamarck)
Family SPATANGIDAE	75.	<i>Nacospatangus (Pseudomaretia) alta</i> (A. Agassiz)
Family LOVENIIDAE	76.	<i>Lovenia elongata</i> (Gray)*
Class HOLOTHUROIDEA		
Order ASPIDOCHIROTIDA		
Family SYNALLACTIDAE	77.	<i>Pelopatides insignis</i> Koehler & Vaney #
	78.	<i>Synallactes pellucidus</i> Koehler & Vaney #
Order DENDROCHIROTIDA		
Family PHYLLOPHORIDAE	79.	<i>Actinocucumis typicus</i> Ludwig
	80.	<i>Phyllophorus (Phyllophorella)</i> sp.

Family CUCUMARIIDAE	81.	<i>Cucumaria</i> sp.
	82.	<i>Havelockia versicolor</i> (Semper)
	83.	<i>Leptopentacta imbricata</i> (Semper)#
	84.	<i>Leptopentacta javanicus</i> (Sluiter)
	85.	<i>Pseudocnus echinatus</i> (von Marenzeller) #
	86.	<i>Pseudocolochirus violaceus</i> Théel
	87.	<i>Stolus buccalis</i> (Stimpson)
Order APODIDA		
Family SYNAPTIDAE	88.	<i>Anapta gracilis</i> Semper
	89.	<i>Protankyra conferta</i> Koehler & Vaney #
	90.	<i>Protankyra denticulata</i> Koehler & Vaney #
	91.	<i>Protankyra inflexa</i> Koehler & Vaney#**
	92.	<i>Protankyra similis</i> (Semper)#
	93.	<i>Protankyra tristis</i> Koehler and Vaney #
	94.	<i>Psamothuria ganapati</i> Rao
Family MYRIOTROCHIDAE	95.	<i>Ankyloderma contortum</i> Koehler & Vaney#
	96.	<i>Ankyloderma intermedium</i> Koehler & Vaney#
	97.	<i>Ankyloderma musculus</i> (Risso)#
	98.	<i>Ankyloderma polymorphium</i> Koehler & Vaney#
	99.	<i>Trochostoma albicans</i> Koehler & Vaney#
Order MALPADIIDA		
Family CAUDINIDAE	100.	<i>Acaudina molpadioides</i> (Semper)

APPENDIX-II

Classified list of echinoderms of Orissa Coast (* spp. new to Orissa, ** spp. new to India, # deepwater spp.)		
Phylum ECHINODERMATA		
Class CRINOIDEA		
Order COMATULIDA		
Family HIMEROMETRIDAE	1.	<i>Heterometra bengalensis</i> (Hartlaub)
	2.	<i>Heterometra reynaudi</i> (Müller)
Family MARIAMETRIDAE	3.	<i>Dichrometra ciliata</i> A, H. Clark
Family COLOBOMETRIDAE	4.	<i>Cenometra herdmani</i> A, H. Clark
	5.	<i>Oligometra imbricata</i> A, H. Clark
	6.	<i>Oligometra serripinna</i> (P. H. Carpenter)
Class ASTEROIDEA		
Order PAXILLOSIDA		
Family LUIDIIDAE	7.	<i>Luidia (Luidia) limbata</i> Sladen
	8.	<i>Luidia (Luidia) maculata</i> Müller & Troschel
Family ASTROPECTINIDAE	9.	<i>Astropecten bengalensis</i> Döderlein
	10.	<i>Astropecten indicus</i> Döderlein
	11.	<i>Astropecten monacanthus</i> Sladen
	12.	<i>Astropecten vappa</i> Müller & Troschel*
	13.	<i>Astropecten velitaris</i> v. Martens**
	14.	<i>Craspidaster hesperus</i> (Müller & Troschel)
Order VALVATIDA		
Family GONIASTERIDAE	15.	<i>Stellaster childreni</i> Gray
Family OREASTERIDAE	16.	<i>Anthenea pentagonula</i> Lamarck
	17.	<i>Goniodiscater vallei</i> (Koehler)
Order SPINULOSIDA		
Family ECHINASTERIDAE	18.	<i>Echinaster purpureus</i> (Gray)
Family METRODIRIDAE	19.	<i>Metrodira subulata</i> Gray
Class OPHIUROIDEA		
Order PHRYNOPHIURIDA		
Family OPHIOMYXIDAE	20.	<i>Ophiomyxa australis</i> Lütken
Order OPHIURIDA		
Family OPHIURIDAE		
Subfamily OPHIURINAE	21.	<i>Ophiura kinbergi</i> (Ljungman)

Family OPHIONEREIDAE	22.	<i>Ophiochiton ambulator</i> *#
Family OPHIACANTHIDAE	23.	<i>Ophiacantha vagans</i> Koehler
Family OPHIACTIDAE	24.	<i>Ophiactis savignyi</i> (Müller & Troschel)
Family AMPHIURIDAE	25.	<i>Amphioplus (Lymanella) depressus</i> (Ljungman)
	26.	<i>Dougaloplus echinatus</i> (Ljungman)
	27.	<i>Ophiostigma formosa</i> (Lütken)
Family OPHIOTHRICIDAE	28.	? <i>Macrophiothrix hirsuta</i> (Müller & Troschel)
	29.	<i>Macrophiothrix longipeda</i> *
	30.	<i>Ophiogymna pellicula</i> (Duncan)
	31.	<i>Ophiothela danae</i> Verrill
	32.	<i>Ophiothrix (Ophiothrix) ciliaris</i> (Lamarck)
	33.	<i>Ophiothrix (Ophiothrix) foveolata</i> Marktanner-Turneretscher
	34.	<i>Ophiothrix (Placophiothrix) striolata</i> Grube
Class ECHINOIDEA		
Order CIDAROIDA		
Family CIDARIIDAE	35.	<i>Stereocidaris alcocki</i> (Anderson)#
Order DIADEMATOIDA		
Family DIADEMATIDAE	36.	<i>Astropyga radiata</i> (Leske)
	37.	<i>Chaetodiadema granulatum</i> Mortensen
Order TEMNOPLEUROIDA		
Family TEMNOPLEURIDAE	38.	<i>Salmaciella dussumieri</i> (L. Agassiz & Desor)
	39.	<i>Salmacis bicolor</i> L. Agassiz
	40.	<i>Temnopleurus toreumaticus</i> (Leske)
Order ECHINOIDA		
Order HOLECTYPOIDA		
Order CLYPESTEROIDA		
Family CLYPEASTERIDAE	41.	<i>Clypeaster rarispinus</i> de Meijere
Family LAGANIDAE	42.	<i>Laganum decagonale</i> (de Blaineville)
Family ASTRICLYPEIDAE	43.	<i>Echinodiscus auritus</i> Leske
	44.	<i>Echinodiscus bisperforatus</i> Leske
Order CASSIDULOIDA		
Family ECHINOLAMPADIDAE	45.	<i>Echinolampas alexandri</i> de Loriol
	46.	<i>Echinolampas ovata</i> (Leske)
Order SPATANGOIDA		
Family BRISSIDAE	47.	<i>Brissopsis luzonica</i> (Gray)

	48.	<i>Rhynobrissus pyramidalis</i> A. Agassiz
Family SPATANGIDAE	49.	<i>Nacospatangus (Pseudomaretia) alta</i> (A. Agassiz)
Family LOVENIIDAE	50.	<i>Lovenia subcarinata</i> (Gray)
Class HOLOTHUROIDEA		
Order DENDROCHIROTIDA		
Family CUCUMARIIDAE	51.	<i>Cucumaria ardens</i> Koehler & Vaney
	52.	<i>Cucumaria inflexa</i> Koehler & Vaney#
	53.	<i>Leptopentacta imbricata</i> (Semper)
	54.	<i>Leptopentacta javanicus</i> (Sluiter)*
	55.	<i>Pseudocnus echinatus</i> (von Marenzeller)
	56.	<i>Pseudocolochirus violaceus</i> (Théel)
Order MALPADIIDA		
Family CAUDINIDAE	57.	<i>Acaudina molpadioides</i> (Semper)

PLATE-I



Fig. 1. *Lamprometra palmata*



Fig. 2. *Tropioometra carinata*

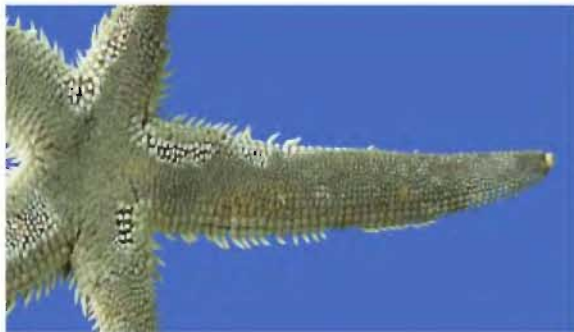


Fig. 3. *Luidia hardwicki* (abactinal view)



Fig. 4. *Luidia hardwicki* (actinal view)

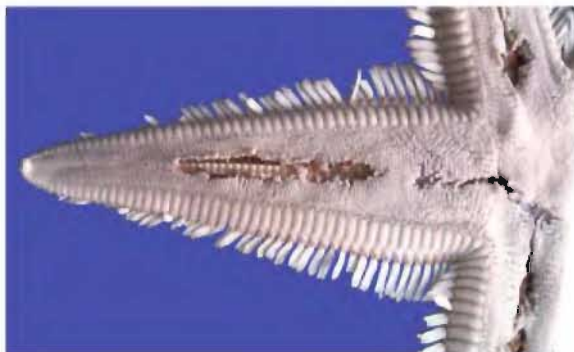


Fig. 5. *Astropecten euryacanthus* (abactinal view)



Fig. 6. *Astropecten euryacanthus* (actinal view)

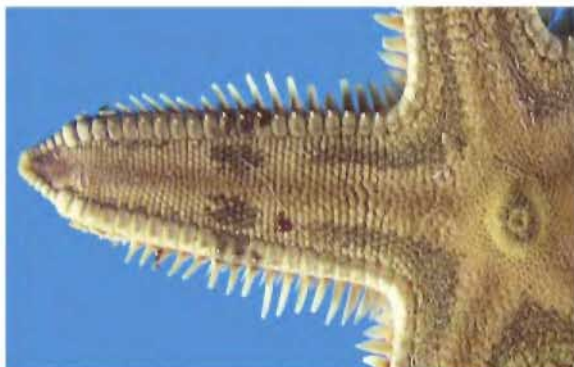


Fig. 7. *Astropecten monacanthus* (abactinal view)



Fig. 8. *Astropecten monacanthus* (actinal view)

PLATE-II

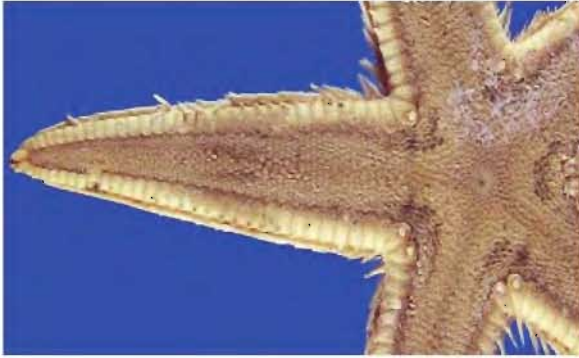


Fig. 9. *Astropecten velitaris* (abactinal view)



Fig. 10. *Asterina lorioli* (abactinal view)



Fig. 11. *Anthenea pentagonula* (abactinal view)

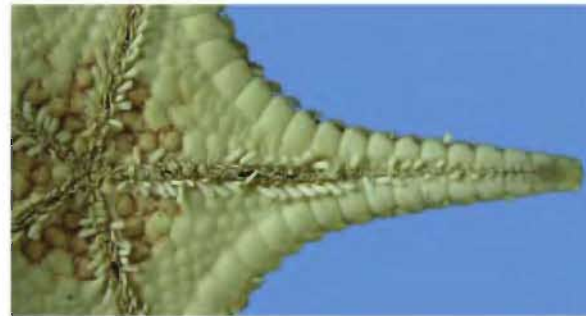


Fig. 12. *Anthenea pentagonula* (actinal view)



Fig. 13. *Pentaceraster affinis* (abactinal view)

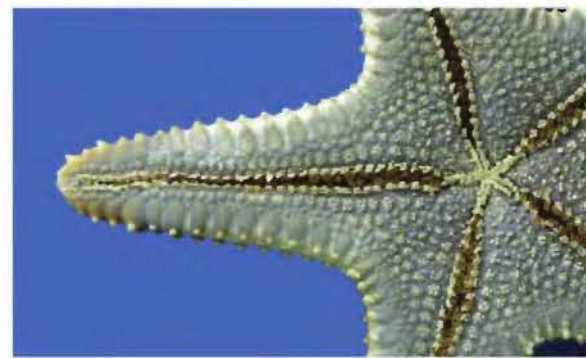


Fig. 14. *Pentaceraster affinis* (actinal view)



Fig. 15. *Echinaster purpureus* (abactinal view)

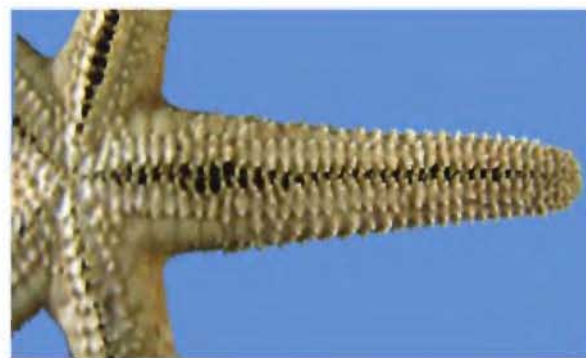


Fig. 16. *Echinaster purpureus* (actinal view)

PLATE-III



Fig. 17. *Ophiochiton ambulator* (dorsal view)



Fig. 18. *Amphioplus depressus* (dorsal view)



Fig. 19. *Amphioplus depressus* (ventral view)



Fig. 20. *Amphioplus hastatus*
(dorsal view of specimen from St. 7/1)



Fig. 21. *Amphioplus hastatus*
(dorsal view of specimen from St. 3/2)

PLATE-IV

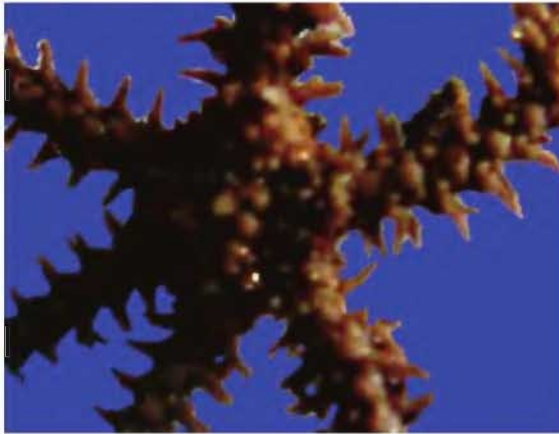


Fig. 22. *Ophiothela danae* (dorsal view)

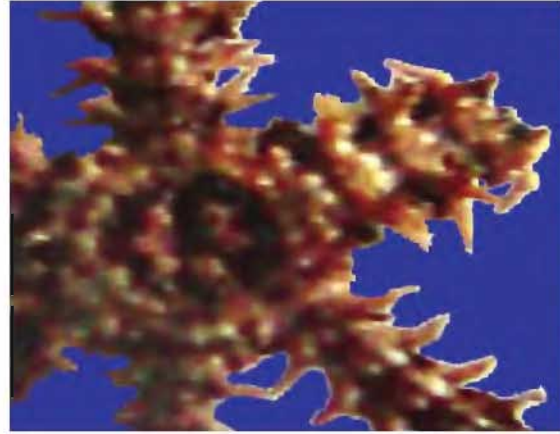


Fig. 23. *Ophiothela danae* (ventral view)



Fig. 24. *Ophiocnemis marmorata* (dorsal view)



Fig. 25. *Chaetodiadema granulatum* (apical view)



Fig. 26. *Salmacis virgulata* (apical view)

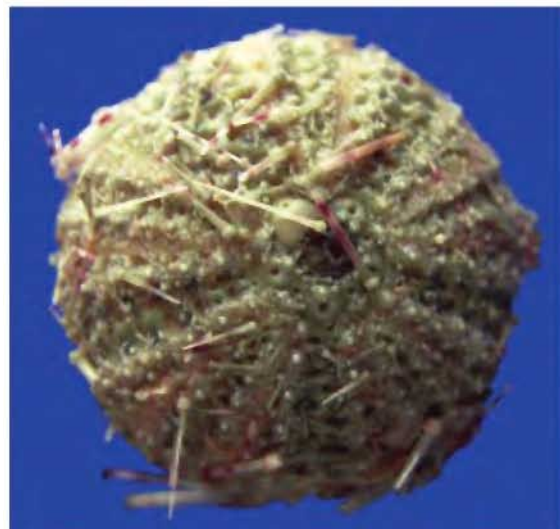


Fig. 27. *Temnopleurus toreumaticus* (apical view)

PLATE-V



Fig. 28. *Clypeaster humilis*
(apical view)



Fig. 29. *Clypeaster rarispinus*
(apical view)



Fig. 30. *Clypeaster rarispinus*
(oral view)



Fig. 31. *Laganum decagonale*
(apical view)



Fig. 32. *Laganum decagonale*
(oral view)



Fig. 33. *Echinodiscus auritus*
(apical view)



Fig. 34. *Echinolampas ovatus*
(apical view)



Fig. 35. *Echinolampas ovatus*
(oral view)



Fig. 36. *Brissopsis luzonica*
(apical view)

PLATE-VI



Fig. 37. *Nacospatangus alta* (apical view)



Fig. 38. *Nacospatangus alta* (oral view)



Fig. 39. *Stomopneustes variolaris* (apical view)



Fig. 40. *Echinometra mathaei* (apical view)

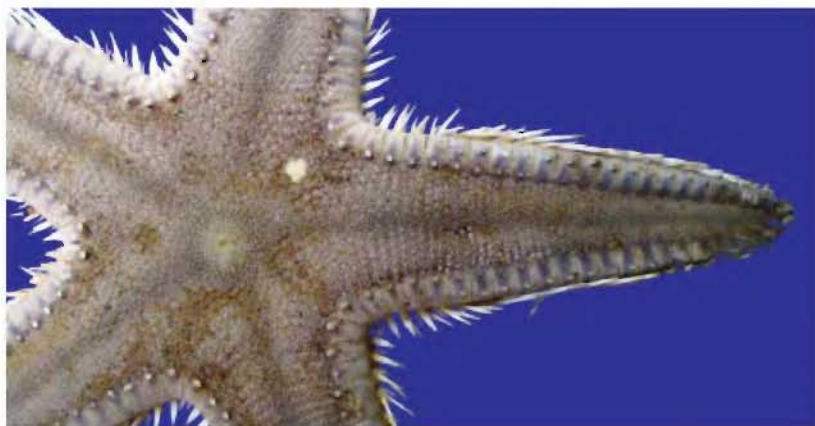


Fig. 41. *Astropecten vappa* (abactinal view)