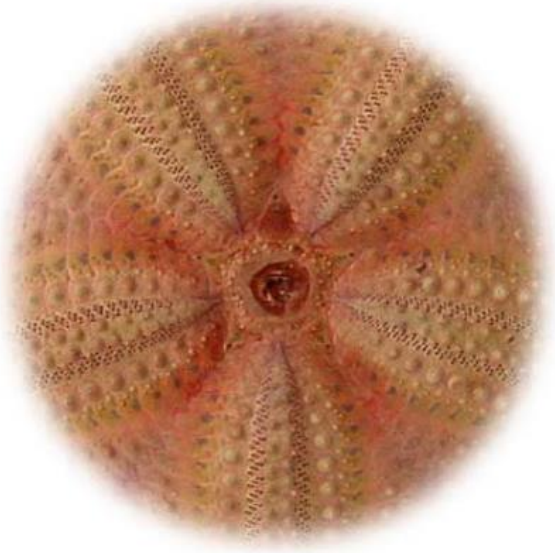
Some
Sea Urchins of Sri Lanka
in Colour

Malik Fernando



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INTRODUCTION

This article on sea urchins is one of five in a series illustrating and describing Echinoderms seen and collected or photographed in Sri Lankan waters by the author and other divers. They have been identified using the key in a British Museum (Natural History) publication by Clark & Rowe on the *Shallow-water Echinoderms of the Indo-Pacific*, 1971. The names have been verified using internet resources through the World Register of Marine Species (WoRMS). Recent work on this group has been published by Arachchige et al, 2017 & 2019 and identifications and names have been revised accordingly. The tests and spines of many of the species described here are available for study in the author's collection.

Sea urchins are members of a large group of exclusively marine invertebrate animals that constitute the Phylum Echinodermata. This phylum is made up of five classes: CRINOIDEA (Feather stars), ASTEROIDEA (Starfish), OPHIUROIDEA (Brittle stars), ECHINOIDEA (Sea urchins) and HOLOTHUROIDEA (Sea cucumbers).

All echinoderms have a body plan based on five radiating axes (though this may be obscured in some), a skeleton consisting of calcareous plates on the outside (reduced to spicules embedded in the skin in the sea cucumbers) and a system of tube feet. Both starfish and sea urchins possess spines: immovable in the former, long, articulated and moveable in the latter (**Figure 1**). The sea urchin skeleton of plates is termed the *test.*

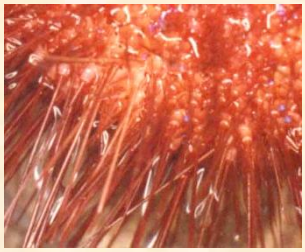


Figure 1
Astropyga radiata showing spines and their articulations. Each ball & socket joint is sealed within a collar of membrane. The longest spines are the primary spines.

Sea urchins are found in a variety of habitats that include sandy bottoms, rocky reefs and coral reefs. Some forms burrow in sand and others burrow into soft rock. Many sea urchins are grazers and help control algal overgrowth. Most live in fairly quiet sub-tidal habitats but one species (*Stomopneustes variolaris*) lives in turbulent water on shallow rocky reefs and inter-tidal pools - these are the animals familiar to most. Their tests (the skeletons - see below) are often washed up on beaches. The tests of some of the flattened forms called 'sand dollars' (see below) may also be found cast ashore on gently shelving beaches.

Sea urchins come in a variety of shapes: the commonly seen animals are more or less spherical or hemispherical with their mouths underneath and the anus at the top. These are

termed regular sea urchins on account of their radially symmetrical shape with no definite anterior or posterior, right or left sides. Depressed urchins are quite flattened and disc-like ('sand dollars') with the mouth and anus both underneath, while the irregular urchins, 'sea potatoes' and 'heart urchins,' are more or less shaped like eggs on their sides with the mouth underneath in front and the anuses at the rear. These latter two forms possess a distinct anterior and posterior with right and left sides (bilateral symmetry) unlike the radial symmetry of the other echinoderms.

Identification of sea urchins is principally by examination of the 'test' - the eggshell-like skeleton. This is covered by knobs on which spines articulate with five paired rows of perforations that extend from the upper pole to the lower through which protrude the 'tube feet' that are used for locomotion and respiration - the ambulacra (Figure 2). Tube feet are hollow extensible structures connected to an internal system of fluid-containing channels (the water vascular system). They are tipped by suction discs with which the animals cling to hard objects like rocks. However, the forms that burrow in sand do not possess suckers. The water vascular system is open to the sea through tiny pores on a structure called the madreporite that is located at the top of the animal in what is called the 'apical system'. Apical systems usually contain in addition the genital pores and, in the regular urchins, the anus (Figure 3). The regular urchins and the depressed forms have five jaws ending in teeth that surround the mouth. These structures are called 'Aristotle's lanterns' and are used to scrape the substrate for the organic matter that is their food (Figures 4 & 5). Sand dwellers take in sand and extract the organic matter, passing the rest out through the anus. The arrangement of these structures vary with the genus and sometimes the species. Spine character and colour are often required to separate species. It is generally possible to identify a bare test to genus level, but not always to species level.

Figure 2
An ambulacrum of *Diadema savignyi.* The ambulacral plates are dark purplish with staggered rows of paired perforations joined by grooves, so they look dumbbell shaped. Primary spines articulate on the large knobs with central perforations, secondary spines on the smaller knobs in the two rows between the ambulacra. The smallest knobs are for miliary spines that fill in the spaces.

This collection of photographs by the author shows some of the Island's many sea urchins. Many have been photographed underwater in their natural habitat, some in aquaria. A number of species are collected for the ornamental marine aquarium trade and

some animals have been obtained from these sources. Whereas most of the species of regular sea urchins are illustrated with photographs of the live animal as well as of the bare test, only the test is shown in two and only an underwater photograph of one - of the only protected species that was not collected. The depressed and irregular species are illustrated mostly with photographs of the bare test only. These tests have been usually found lying on the bottom while diving: dredging for live animals was never practiced. Rarely, live animals were seen on the surface of the seabed or found just under the surface in shallow water.

Figure 3
The apical system of *Tripneustes gratilla*. The anal sac is at the centre. The five radiating dark rays are the inter-ambulacral plates that separate the paired ambulacral plates perforated for the tube feet. At the top of the inter-ambulacra are five enlarged plates with the genital pores that show as black dots; the plate in the 12 o'clock position has a darker base marking the *madreporite* - the external communication of the water vascular system.

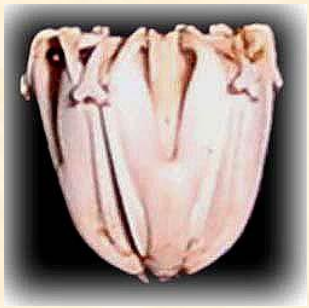
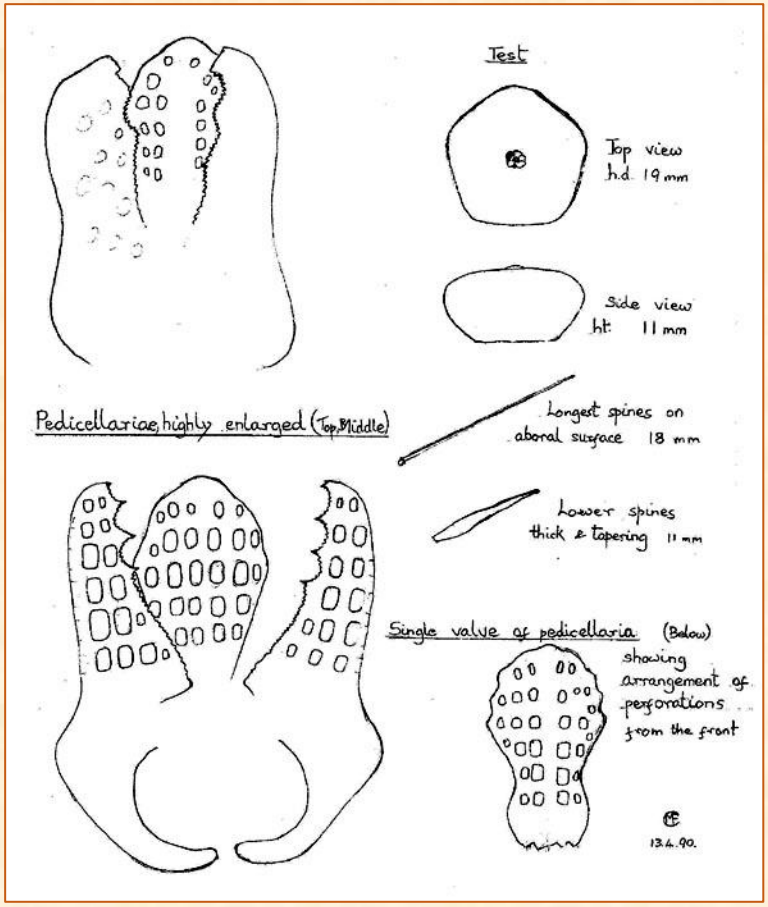
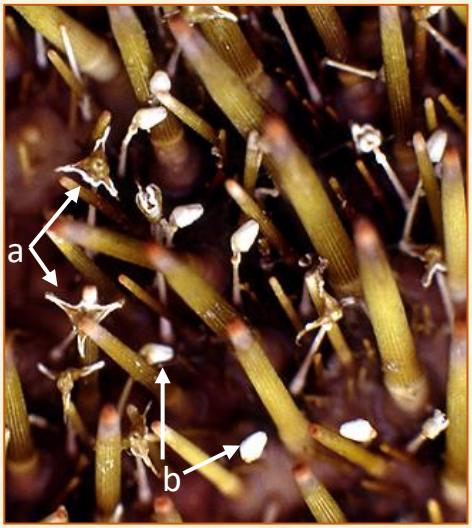


Figure 4
The Aristotle's lantern of *Stomopneustes variolaris* seen from the side. The teeth are below. Actual height 10 mm.

Figure 5
The teeth of *Astropyga radiata* in a living animal seen from below. At left, the five white teeth are in the retracted position and at right, they have closed in a bite.

Pedicellariae





Pedicellariae are structures possessed by many Echinoderms. They are defensive, the primary task being to protect the animal from organisms that may attempt to colonise the exterior. There are four types—two being important in identifying species.

The right-hand image shows globiferous pedicellariae with their three jaws wide open (a), and the smaller ophicephalous pedicellariae (b) of *Toxopneustes pileolus*.

The left-hand image is a drawing of a pedicellaria from *Echinostrephous molaris*, shown highly magnified.

The diversity of Sea Urchins (Echinoids) in Sri Lanka

The Echinoids of Sri Lanka and the Gulf of Mannar have been studied by many people since 1846. Studies by Sri Lankan researchers have been few and far between. A recent paper drawing attention to echinoids was the article by Fernando (2006) titled Coral Associated Invertebrates: An Overview of the Current Taxonomic Status. This paper contained a checklist of the Echinoderms of Sri Lanka compiled from the reports by Clark & Rowe (1971) of species reported from the "Ceylon Area" as well as his recent collections. The species *Echinoneus abnormalis, Prymnastor* ? *investigatoris* and *Metalia dicrana* were reported as new records collected by him. *Koehleraster abnormalis* (de Loriol, 1883) (=*Echinoneus abnormalis*) was subsequently confirmed in Sri Lanka (Arachchige et al, 2019).

Sevvandi Jayakody (2010) compiled a provisional checklist based on publications that included that by Fernando (2006), as well as her own records for the National Red List 2010 of Sri Lanka. Provisional checklists, that had nothing to do with the threat status of species, were included in that publication to stimulate researchers to undertake investigations involving fauna that lacked recent data. Jayakody, together with her student Gayashan Arachchige, proceeded to study irregular sea urchins, and published the results in 2014, 2017, and 2019:

- Arachchige et al, 2014 in the abstract titled *Revisiting the taxonomy and distribution of irregular echinoids in Sri Lanka* remarked that "This study highlights previously undocumented diversity of an ecologically important yet difficult-to-study group of infaunal (=burrowing) invertebrates occurring in Sri Lankan coastal waters."
- Arachchige et al, 2017 published an article in the peer reviewed journal Zootaxa titled *A review of previous studies on the Sri Lankan echinoid fauna, with an updated species list.* This is a comprehensive literature review of records of sea urchins collected from waters around Sri Lanka with an updated nomenclature.
- Arachchige et al, 2019 is a monograph in Zootaxa devoted to the irregular sea urchins—the heart urchins and the flattened sand dollars - *Taxonomy and distribution of irregular echinoids (Echinoidea: Irregularia) from Sri Lanka*.

According to these studies there are 46 species of regular sea urchins (Arachchige et al, 2017), and 37 species of irregular sea urchins (Arachchige et al, 2019). These workers restricted their figures to specimens collected in shallow water within the Exclusive Economic Zone of Sri Lanka. The Clark & Rowe Monograph included as within the "Ceylon Area" specimens from the Indian side of the Gulf of Mannar.

The list of species that follows, and the images and descriptions in other parts, is based on the specimens in the Malik Fernando Collection, identified by him based on the Clark & Rowe key. They have not been verified by a taxonomist.

LIST OF SPECIES

REGULAR SEA URCHINS

CIDARIDAE
Phyllacanthus imperialis Lamarck, 1816
DIADEMATIDAE
Astropyga radiata (Leske, 1778)
Diadema savignyi (Audouin, 1809)
Diadema setosum (Leske, 1778)
Echinothrix diadema (Linnaeus, 1757)
ECHINOTHURIDAE
Asthenosoma varium Grube, 1868
ECHINOMETRIDAE
Echinometra mathaei (de Blainville, 1825)
Echinostrephus molaris (de Blainville, 1825)
Heterocentrotus mamillatus (Linnaeus, 1758)
STOMOPNEUSTIDAE
Stomopneustes variolaris (Lamarck,1816)
TEMNOPLEURIDAE
Microcyphus ceylanicus Mortensen, 1942
Salmacis bicolor L. Agassiz in L. Agassiz & Desor, 1846
Salmacis virgulata L. Agassiz in L. Agassiz & Desor, 1846
TOXOPNEUSTIDAE
Pseudoboletia maculata Troschel, 1869
Toxopneustes pileolus (Lamarck, 1816)
Tripneustes gratilla (Linnaeus, 1758)

IRREGULAR SEA URCHINS - FLATTENED

ASTRICLYPEIDAE
Echinodiscus bisperforatus Leske, 1778
Sculpsitechinus auritus Leske, 1778
CLYPEASTERIDAE
Clypeaster humilis (Leske, 1778)
Clypeaster rarispinus de Meijere, 1903
Clypeaster reticulatus (Linnaeus, 1758)
LAGANIDAE
Jacksonaster depressum (L. Agassiz, 1841)
Peronella macroproctes Koehler, 1922
Peronella oblonga Mortensen, 1948

IRREGULAR SEA URCHINS – EGG OR HEART SHAPED

BRISSIDAE
Brissus latecarinatus (Leske, 1778)
Metalia dicrana H. L. Clark, 1917
Metalia sternalis (Lamarck, 1816)
ECHINONEIDAE
Echinoneus cyclostomus Leske, 1778
Koehleraster abnormalis (de Loriol, 1883)
ECHINOLAMPADIDAE
Echinolampas ovata (Leske, 1778)
LOVENIIDAE
Lovenia elongata (Gray, 1845)
MARETIIDAE
Nacospatangus altus (A. Agassiz,1864)
SCHIZASTERIDAE
Schizaster gibberulus L. Agassiz in Agassiz & Desor, 1847
cf. *Prymnaster investigatoris* (Koehler, 1914)

The total number of echinoid species (both regular and irregular) occurring in Sri Lanka stands at 77 species belonging to 48 genera (Arachchige et al, 2017). The diversity of irregular echinoids from Sri Lanka stands at 37 species representing 11 families in four orders. *Peronella oblonga* Mortensen, 1948 is a new record for Sri Lanka. (Arachchige et al, 2019).

The following species included in this compilation have not been collected by Arachchige et al, 2019.

Clypeaster rarispinus de Meijere, 1903

Jacksonaster depressum (L. Agassiz, 1841): Arachchige et al describe two species of *Jacksonaster* as sp. 1 and sp. 2. They note that according to Mortensen, 1948 the posterior margin of *J. depressum* is indented, a feature seen in their specimen *Jacksonaster* sp.1 that is stated to be closest to *J. depressum tenue* (Mortensen, 1948). The specimens in the author's collection all have indented posterior margins and are referred to *J. depressum*. An examination of finer details may necessitate a name change.

Peronella macroproctes Koehler, 1922

Brissus latecarinatus (Leske, 1778): "The Sri Lankan *Brissus* (*B*. cf. *agassizii*) specimens clearly do not belong to *B. latecarinatus* as the periproct is not overhung by the posterior inter-ambulacrum. The posterior end is almost vertically truncated, so that the periproct is not fully visible from the oral side." (Arachchige et al, 2019) The specimens in the author's collection are determined as *B. latecarinatus* based on the Clark & Rowe key. Examination of details of physical features and comparison with other collections may necessitate a change of name.

Metalia dicrana H. L. Clark, 1917: This is a species not reported by Clark & Rowe, 1971 from the Ceylon Area. It is distinguished from other *Metalia* by "its peculiar double point along the sternum just adoral to the subanal fasciole" (Arachchige et al quoting Mooi, unpublished data). This feature is also described in the Clark & Rowe key and is present in the author's specimens.

Schizaster gibberulus L. Agassiz in Agassiz & Desor, 1847

cf. *Prymnaster investigatoris* (Koehler, 1914)

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