The diversity of Echinoderm in Sarangan beach, Gunung Kidul, Yogyakarta

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Abstract. Sarangan beach at the coast of Gunung Kidul is dominated by substrates of sand, coral, and macroalgae where Echinodermata was found. This research was conducted to determine the diversity of echinoderms on that beach. Field observation was carried out during maximum low tide. Sampling was carried out by applying random sampling method. Specimens were preserved and identified. The sampled specimens consisted of a member of class Asteroidea (Anthenea sp), members of Ophiuroidea (Ophiocoma scolopendrina, Ophiomastix annulosa, and Ophiocoma erinaceus), members of Echinoidea (Colobocentrotus atratus, Heterocentrotus trigonarius, Stomopneustes variolaris, and Echinometra sp.).

Keywords: diversity, echinoderms, Sarangan beach

1. Introduction

Phylum Echinodermata is divided into five classes, they are Asteroidea (starfish), Ophiuroidea (brittle star), Echinoidea (sea urchin), Holothuroidea (sea cucumber), and Crinoidea (sea lilies). Echinodermata is a pentamer radially symmetrical marine animal with a body constituent in the form of CaCO3 and has a spine on its body surface. Members of the phylum Echinodermata have a water vascular system which functions to transport and distribute water through the body for body movements. All members of this phylum are found in the sea, from shallow sea to deep. Members of this phylum include Holothuroidea (sea cucumber), Echinoidea (sea urchins), Asteroidea (starfish), Ophiuroidea (brittle star), and Crinoidea (sea lilies). Each class of Echinodermata has its own characteristics and has a different habitat. Asteroidea and Echinoidea are usually found in intertidal areas with rocky substrates. Ophiuroidea and Holothuroidea can be found in areas with seagrass substrates. crinoidea is usually found in shallow sea to deep sea (Emlet 2007). Ecologically echinoderms play a role in the food chain (food web) which is generally as eaters of detritus and predators in coral reef ecosystem (Birkeland et al 1989).
Sarangan beach is one of the beaches in Gunung Kidul regency with the dominant substrate are corals and algae. This beach is dominated by coral rock with marine biota which is one of them is echinodermata. Research on the diversity of specific echinoderms in echinoidea and ophiuroidea in Sarangan beach has not been done, so this study aims to explore further about the diversity of echinoderms, especially echinoidea and ophiuroidea classes and study the specific characters of each species.

2. Materials and methods

This research was conducted in intertidal zone of Sarangan Beach, Ngestirejo, Tanjungsari, Gunung Kidul, Yogyakarta on October 2\textsuperscript{nd}, 2018 at 04.30-07.00 WIB. Sarangan Beach is located at the coordinates of -8.147234, 110.597162 (figure 1). Sarangan Beach substrates are dominated by sand, coral, and macroalgae. Samples were taken by purposive random sampling method.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.jpg}
\caption{Map of the research site in Sarangan Beach, Gunung kidul, Yogyakarta.}
\end{figure}

2.1. Materials

The materials for this research were chemical reagent, alcohol 70% for preservation and fixation. Research equipment included pinset to collect Echinoderms from the coral, hammer to break the coral to collect Echinoderms, and ruler, millimeter block, jam bottles and camera.

2.2. Methods

Samples of specimens were collected by purposive random sampling method. The collected samples were then preserved using chemical reagent. The chemical used was alcohol 70% for fixation. The specimens were injected in the aboral part with 70% alcohol, then placed in a bottle jam containing alcohol of 70% for preservatione. The specimens were identified from their morphological characteristics using the key taxonomic classification as a guide, namely the \textit{Monograph of Shallow-Water Indo-West Pacific Echinoderms} (Clark and Rowe 1971).
3. Results and discussion

Eight species of echinoderms were found in the samples from Sarangan beach, Gunung Kidul, Yogyakarta (table 1).

3.1. Asteroidae
The only one species found in samples belong to family Oreasteridae was Anthenea sp (figure 2). Each pedicellaria in Anthenea sp. is small, narrow, oblong, calcareous body, consisting of two parallel narrow valves or jaws which are instead of being supported on a flexible stalk, these are articulated with the edges of a slit-like depression on the surface of the flat ossicle, and are thus on a level with the general surface (Parker et al. 1930). Three or more series of spines on the ambulacral plates, arms usually triangular, or tapering to a blunt tip, and carinal rows of tubercles not conspicuously enlarged (Clark and Rowe 1971).

| No | Family             | Species                                      |
|----|--------------------|----------------------------------------------|
| 1  | Asteroidae         | Anthenea sp. (Döderlein 1915)                |
| 2  | Ophiocomidae       | Ophiocoma scolopendrina (Lamarck 1816)       |
|    |                    | Ophiomastix annulosa (Lamarck 1816)          |
|    |                    | Ophiocoma erinaceus (Müller and Troschel 1842) |
| 3  | Echinometridae     | Colobocentrotus atratus (Linnaeus 1758)      |
|    |                    | Heterocentrotus trigonarius (Lamarck 1816)   |
|    |                    | Echinometra sp. (Gray 1825)                  |
| 4  | Stomopneustidae    | Stomopneustes variolaris (Lamarck 1816)      |

Figure 2. Anthenea sp. (a) aboral side, (b) oral.

3.2. Ophiocomidae
The Ophiocoma species (figure 3, 4 and 5) was distributed not only in the tropic littoral water, but also found in subtropical regions. Species of the genus Ophiocoma is often found dominate the coral reef cryptofauna (Sloan et al 1979). O. scolopendrina is a member of Ophiocoma which commonly found in intertidal rocks pool and under boulders throughout Indo-Pacific (Byrne and O’Hara 2017). This species appears to be well adapted in extreme environments/conditions, it can tolerate temperatures up to 40°C, and wide variation in water salinity (Magnus 1967, Oak and Scheibling 2006). Because of this ability, this species is widespread on the beaches in Gunung Kidul, especially in Sarangan beach.
O. scolopendrina has a lighter body color on underneath and darker on the upper part of its body. O. scolopendrina takes food using several of its arms by filtration or by sweeping the substrate or surface of water. The unique way of feeding behaviour of this species namely "surface-film feeding" (Byrne and O’Hara 2017, Magnus 1967, Jones and Endean 1976). The main food source of O. scolopendrina is particles or material suspended in the sea and also bacteria attached to the sediment. Thus, this species has an important role in the tropodynamics of coral reefs, which is a link between decomposers, major producers and high-level consumers.

O. scolopendrina commonly has diagnostic characters there are disc granulation coarse, 3-6 granules/mm length, uppermost arm spines usually thickened and cigar-shaped or cylindrical, rarely tapering, the longest averaging 0.2-3 times the segment length but sometimes exceeding 3 times, often no more than four arm spines basally, even at diameters >20 mm. Color paler on the underside, variegated or sometimes uniformly dark above (Clark and Rowe 1971).

![Figure 3](image1.png)

Figure 3. Ophiocoma scolopendrina (a) aboral side, (b) oral side.

![Figure 4](image2.png)

Figure 4. Ophiomastix annulosa (a) aboral side, (b) oral side.

O. annulosa can be found beneath coral slabs, holes, and crevices. Possesses enlarged, modified, venomous spines. O. annulosa distributed in Netherlands New Guinea, Maldive, North Australia, Phillipine, China, South Japan, Tropical East Indo-West-Central Pacific Ocean. It associated with O. scolopendrina may serve as its strategy in obtaining food from the host’s arms (Fourgon et al 2006). It can
be found in the depth range from 4-11 meters (Fujita and Liao 2001). This species has pink colors on the dorsal and ventral side, granule and spinelet in the dorsal disk. *O. annulosa* commonly has diagnostic characters that are light-coloured rim all round each dorsal arm plate contrasting with the dusky colour of the rest of the arm, oral shield patterned with concentric dark and light rings, two tentacle scales, and the disc spines blunt (Clark and Rowe 1971).

![Figure 5](image)

**Figure 5. Ophiocoma erinaceus** (a) aboral side, (b) oral side.

*O. erinaceus* has almost similar characters with *O. scolopendrina*. *O. erinaceus* is often found in deeper water in coral heads (Sloan *et al* 1979). *O. erinaceus* inhabit coral heads, and a range of other species live under coral rubble and clumps of the green alga Halimeda. This species has ability to change its colour (Byrne and O’Hara 2017).

Diagnostic characters of *O. erinaceus* are two tentacle scales, colour uniformly dark, above, and below, uppermost arm spines usually cylindrical or cigar-shaped, sometimes (some specimens of *O. erinaceus*) somewhat clavate but then alternate ones on each side of the arm are so modified; arm spines not banded though sometimes spotted; usually two tentacle scales, sometimes only one beyond the basal segments (Clark and Rowe 1971).

### 3.3. Echinometridae

Three species members of Echinometridae belong to genus *Echinometra* (figure 6, 7 and 8). Genus *Echinometra* are commonly found from shallow waters between the average low tide and depths of 10 m. *Echinometra* is a generalized herbivore, feeding on a variety of algae and seagrass, but occasionally consumes benthic animals, such as sponges and corals. It is usually found masticated algae and also sediments in *Echinometra*’s gut. *Echinometra* with little sediment in the gut are probably feeding on drift algae, but may be eating abundant fleshy algae in areas with low sedimentation (Lawrence 2007).

*Heterocentrotus trigonarius* has a test that extends along the ocular plate II and genital plate 4. Apical disc is dicyclic; periproct is relatively small. Has 9 to 14 pore pairs in each plate. All ambulacral plates have a single primary tubercle that fills the entire surface of the plate. Interambulacral plates have a large primary tubercle with a very large and thickened mammelon in the ambitus. There is a secondary tubercle attached to the surface of the aboral surface. Has an elliptical peristome with a buccal curve (Brandt 1835)
Figure 6. *Echinometra* sp. (a) aboral side, (b) oral side.

Figure 7. *Heterocentrotus trigonarius* (a) aboral side, (b) oral side.

Figure 8. *Colobocentrotus atratus* (a) aboral side, (b) oral side.

*C. atratus* is a sea urchin belonging to the family Echinometridae. *C. atratus* is commonly known as shingle urchin or helmet urchin. Aboral spine is reduced and has the same length, which is a solid base structure. The oral part of the spina is flattened (Pandey and Ganesh 2016). *C. atratus* lives in intertidal areas with extreme waves, commonly found in the Indo-Pacific region. *C. atratus* belongs to the
endangered species. This animal can also be used as raw material for medicine (Pandey and Ganesh 2016).

3.4. Stomopneustidae

*Stomopneustes variolaris* or known as black sea urchin (figure 9) is one of the warmest water species found in the Indian Ocean. They belong to the Stomopneustidae family and are distributed in the tropical and subtropical regions of the Indo-Pacific from the East African coast to Samoa and to the Bonin Islands in the north. They are omnivores that feed on algae and seaweed. The distribution of *S. variolaris* is limited to a depth of up to 18 m (De Zoysa 2017).

![Figure 9. Stomopneustes variolaris (a) aboral side, (b) oral side.](image)

This species has anus in aboral view and mouth in the centre of the oral surface. Test unusually circular in outline, sometimes oval, rigid, rarely somewhat flexible but then undergoing little when preserved. Peristome skin covered, spines bristling and erect. It has low interambulacral plates, the ambital ones at least usually with several primary spines, which are rarely massive, and the secondary spines not arranged in rings but scattered among the primaries. Its spines covered with very thin barely perceptible skin, the primary tubercles imperforate though sometimes crenulate, and has solid spines. No complete bridge across the v-shaped space at the upper end of each of the five pyramids forming the frame Aristotele's lantern in this species. Ambulacral plates doubly compound so that at the ambitus one very large ambulacral tubercle corresponds to three to six arcs each to three pore-pairs (Clark and Rowe 1971).

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