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Morphology and Anatomy of Species *Heterocentrotus trigonarius* and *Tripneustes ventricosus* (Echinodermata: Echinoidea) in Nguyahan Beach Gunungkidul

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Abstract. The basis of this research is a minimum of research on marine life in Nguyahan Beach, especially at the Echinoidea class. Echinoidea is an animal that very important role in the environment as an indicator of sea water pollution. This research discus about morphology and anatomy of the species *Heterocentrotus trigonarius* and *Tripneustes ventricosus* from Nguyahan Beach, Gunungkidul. This research using qualitative method by descriptive type, presenting pictures and descriptions. Discussion of the species *Heterocentrotus trigonarius* and *Tripneustes ventricosus* includes classification, morphology and anatomy. The special characteristics of Echinoidea class are the presence of Aristotle's lantern as an organ alimentary canal and gonads as an organ reproductive.

Keyword : Echinoidea, Morphology, Anatomy

Running Title : Morphology and Anatomy of *Heterocentrotus trigonarius* and *Tripneustes ventricosus* in Nguyahan Beach

NTRODUCTION

Indonesia is listed as the country with the second longest coastline after Canada (Trinanda, 2017). One of the areas in Indonesia where beaches can be found is in Gunugkidul, Yogyakarta province, including Nguyahan beach. Nguyahan Beach is a beach with a rocky structure which is a habitat for Echinoderms. So that it is easy to find animals from the Echinoderms phylum, one of them from the Echinoidea class (Katili, 2011).

Echinoidea is generally divided into two, namely regular Echinoidea and Echinoidea irregular. The species *Heterocentrotus trigonarius* and *Tripneustes ventricosus* include Echinoidea regular. Echinoidea has a unique jaw and teeth, namely Aristotle's lantern. In addition, Echioidea also has *tube feet* for respiration or commonly known as the canal system (Vimono, 2007). Echinoidea body parts are divided into three parts, namely the aboral part, the oral part and the part between the oral and the aboral part.

Heterocentrotus trigonarius is known as *pencils sea* urchin because of its large, pencil-like thorn structure. The species are *Trineustes ventricosus* almost the same as the species *Tripneustes gratilla*, but have different spines. However, several journals state that there is a possibility that the species *Tripneustes ventricosus* and *Tripneustes gratilla* are the same species.

MATERIALS AND METHODS

Research was conducted at Nguyahan beach, Gunungkidul, which is located in Kanigoro village, Saptosari sub-district, Gunungkidul regency, Yogyakarta January to March. Echinoidea were observed in their morphology and anatomy. Echinoidea spines were cut and measured in length using a ruler. Species surgery was performed from the oral to the aboral part in the direction of the ambulacral area.

RESULT AND DISCUSSION

Echinoidea has an endoskeleton in the form of a test composed of calcium carbonate and consists of 10 double plates, 5 ambulacral pieces and 5 interambulacral pieces. In the aboral part there is an apical system and in the oral part there is a peristomial system. The apical system consists of a number of anal discs (*periproct*), among which, it consists of the genital disks which lie around the anus. While the peristomial system is found in the skin membrane where the Aristotel's lantern organ attaches (Sugiarto, 1995). Echinoidea have several main organs such as tests, spines, *tube feet*¸ Aristotle lanterns and gonads.

Echinoidea soft tissue anatomy is characterized by the presence of a dominant digestive tract, a variable number of gonads and a vascular or canal system. The space between the main organ systems consists of a main body cavity called the *perivisceral coelom* (Ruppert, *et.al*, 2005).

The test of Echinoidea is composed of several *ossicles* that form around the mouth. In the ambulacral area there are small holes through which exit *tube feet*. In addition, there are also protrusions where the thorn is attached, called the tubercle. The tubercle with spines is connected by connective tissue as well as muscle tissue. Echinoidea spines vary in length and shape. Several species of Echinoidea have spines that are poisonous and very dangerous if punctured (Vimono, 2007).

Tube feet Echinoidea used in movement, catch food particles and in the process of respiration. The process of respiration in Echinoidea uses a canal system with the help of an external organ in the form of *tube feet*. Echinoideal respiration is divided into

several stages. First, water enters through a gap in the *madreporit*. Second, water flows with the help of cilia and is channeled into a channel called a *stone canal*. Third, water enters *the canal ring* and then fills the tube leg so that the tube leg sticks out and respiration occurs. *The canal ring* that is included in the canal system is found on the inside of the Aristotle lantern (Vimono, 2007).

The very important and also characterizes Echinoidea organ is Aristotle's lantern. Aristotle lantern consists of teeth, jaw, bones and muscles. The teeth on the Aristotle lantern are supported by a *pyramid* and also a *retractor* to pull and help the teeth to move in and out (Figure 4 and Figure 9) (Ziegler, *et.al*, 2012). Echinoidea food in the form of algae, seagrass and detritus. The digestion process of Echinoidea begins by catching food using *tube feet* then entering it through the mouth in the oral section, destroyed by Aristotle's lantern, the destroyed food is passed by the pharynx to the esophagus then enters the intestine and leaves in the form of feces through the anus in the aboral section.

The reproductive organs of Echinoidea are gonads consisting of five lobbies attached to the ephitelium of the interambulacral plate. The number of gonads from each lobby of each species is different. Echinoidea is *gonochoric*, so the color and shape of the gonads between males and females are different, but to find out more details, it must be examined microscopically. Gonad size and weight will reach a maximum during the spawning phase (Darsono, 1986).

Heterocentrotus trigonarius

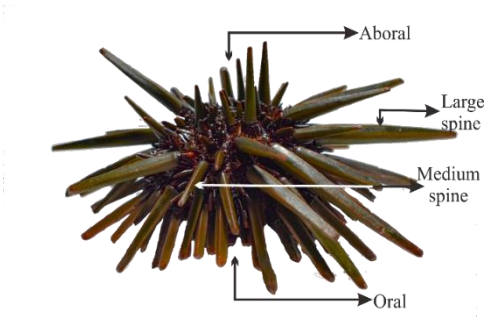

Figure 1 : Echinoidea species *Heterocentrotus trigonarius*

Classification :

Kingdom : Animalia
Phylum : Echinodermata
Class : Echinoidea
Order : Camarodonta
Family : Echinometridae
Genus : *Heterocentrotus*
Species : *Heterocentrotus trigonarius* (Kroh A, 2020)

Heterocentrotus trigoarius has reddish brown spines, is large, long, the tip is blunt and does not break easily. The lengths of all the spines are not the same (figure 1). The spines on the oral side have a short shape with blunt ends (Figure 3), while the aboral ones have short but not too blunt spines (Figure 2). The test *Heterocentrotus trigonarius* is round, brown in color, consisting of five ambulacral pieces and five interambulacral pieces of the same size. So that it is entered into the type of regular Echinoidea. The tubercle of the test protrudes especially where the large, long spines attach. The tubercle on the oral side is less protruding than the other side because the spines attached to the oral side are short (Figure 5).

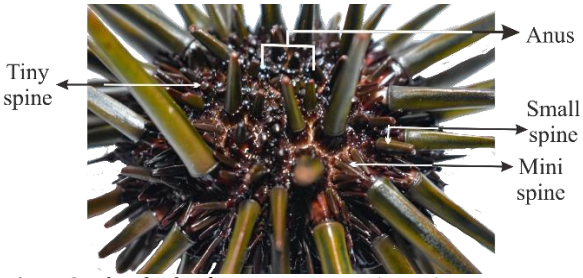

Figure 2 : aboral side of *Heterocentrotus trigonarius*

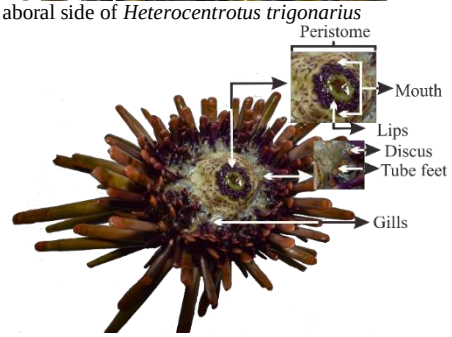

Figure 3 : Oral side of *Heterocentrotus trigonarius*

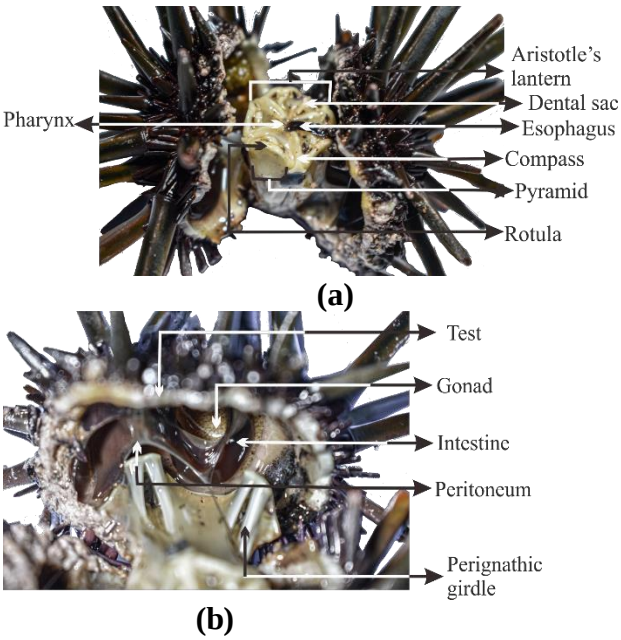

Figure 4 : a & b. Anatomy of *Heterocentrotus trigonarius*

The test Heterocentrotus trigonarius is round, brown in color, consisting of five ambulacral pieces and five interambulacral pieces of the same size. So that it is entered

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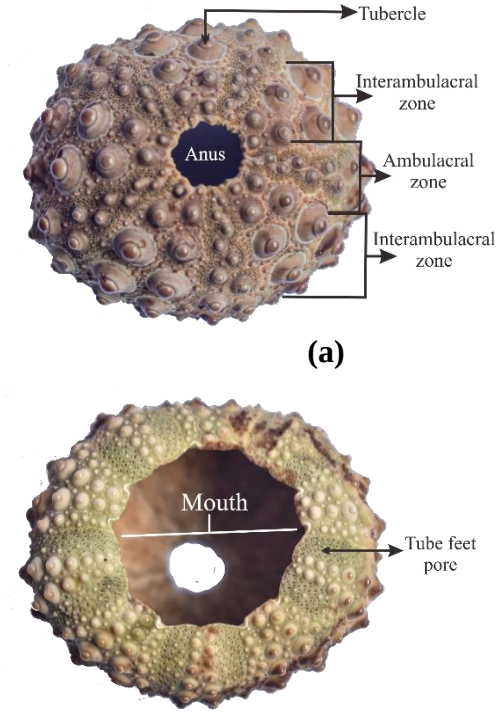


Figure 5 : spine of *Heterocentrotus trigonarius*. (a) aboral side, (b) oral side

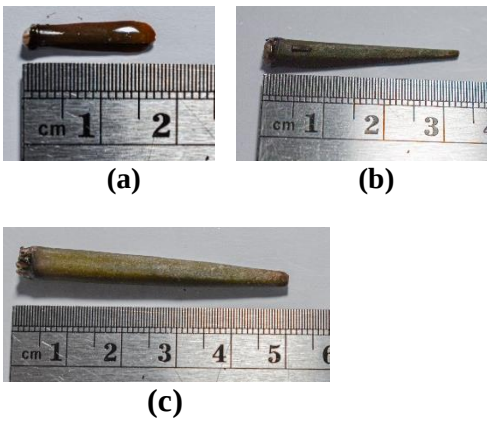


Figure 6 : spine of *Heterocentrotus trigonarius*. (a) spine of aboral side, (b) medium spine, (c) large spine

Tripneustes ventricosus

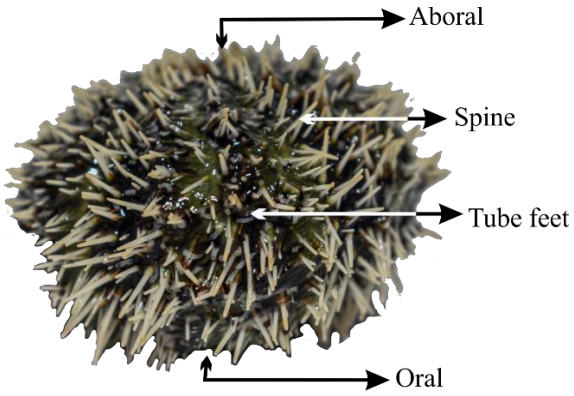


Figure 7 : Echinoidea species *Heterocentrotus trigonarius*

Classification :

Kingdom : Animalia
Phylum : Echinodermata
Class : Echinoidea
Order : Camarodonta
Family : Toxopneustidae
Genus : *Tripneustes*
Species : *Tripneustes ventricosus* (Kroh A, 2020)

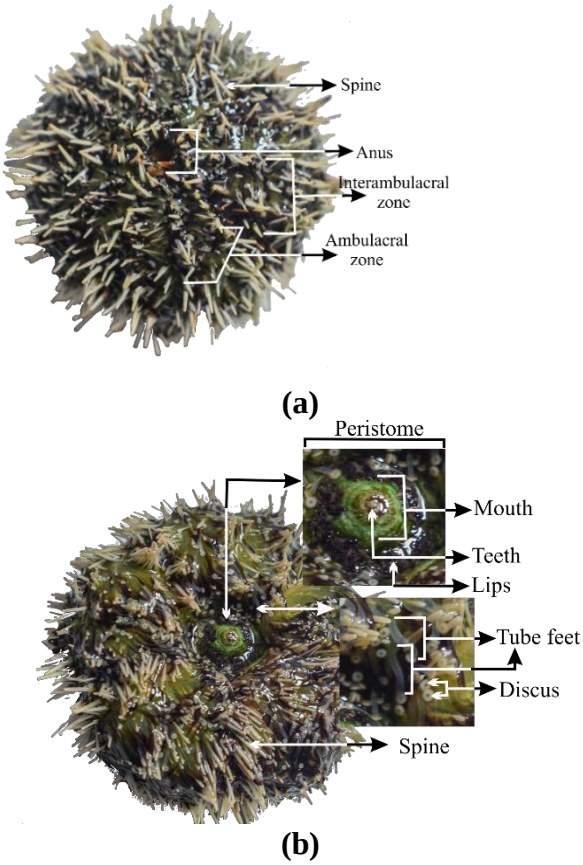


Figure 8 : Morphology of *Heterocentrotus trigonarius*. (a) aboral side, (b) oral side

The species *Tripneustes ventricosus* is round like a ball with short white spines that surround it. Because it has a short spines, *tube feet* on *Tripneustes ventricosus* clearly visible and numerous (figure 7). There are many gonads and it is possible to enter the spawning phase (figure 9).

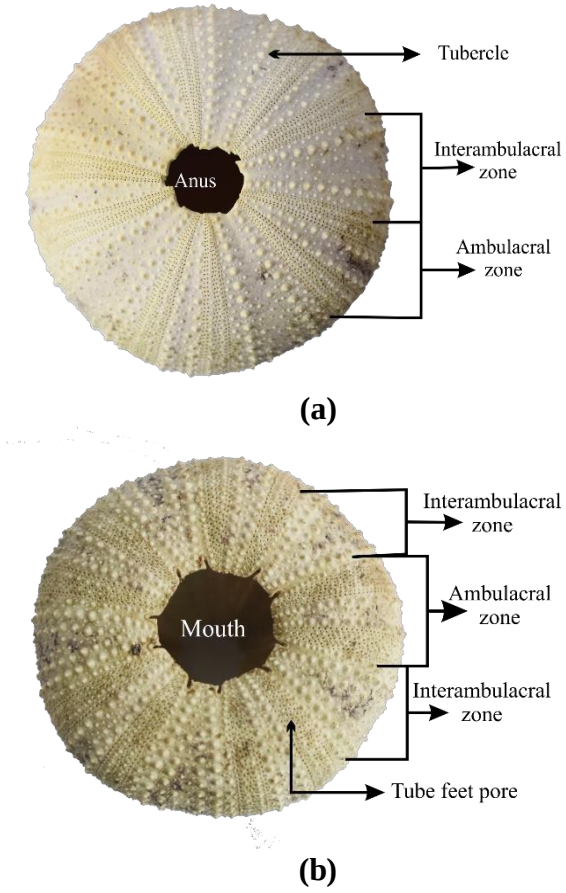
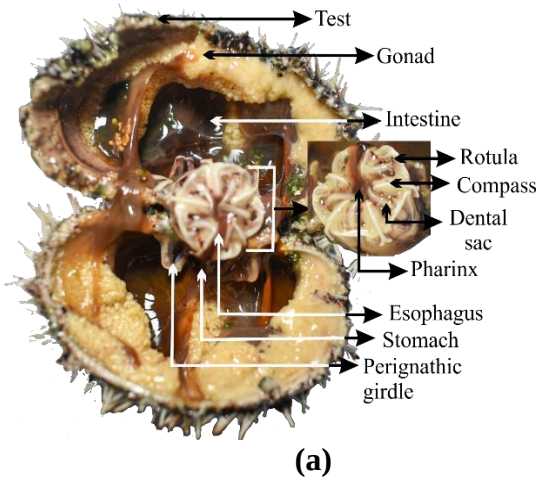


Figure 9 : a & b. Anatomy of *Heterocentrotus trigonarius*.

Tripneustes ventricosus has a round, white test consisting of five ambulacral pieces and five interambulacral pieces of the same size. Therefore, *T. ventricosus* belongs to the regular Echinoidea type.spines are *T. ventricosus* short and small in diameter (Figure 11). So that the tubercle in the test is not too prominent or nearly flat when compared to the species *Heterocentrotus trigonarius* (Figure 10).



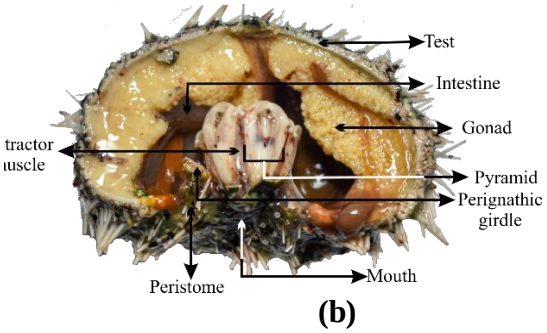


Figure 10 : Test *Heterocentrotus trigonarius*. (a) aboral side, (b) oral side

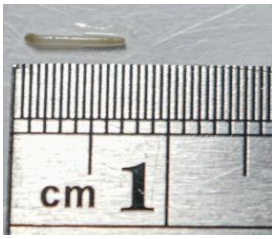


Figure 11 : spine of *Heterocentrotus trigonarius*.

CONCLUSION

Heterocentrotus trigonarius has larger and stronger spines than the spines *Tripneustes ventricosus*. The test shapes of *H. trigonarius* and *T. ventricosus* are both rounded but the tubercle of the test of *H. trigonarius* more prominent. The species *T. ventricosus* were found to have large and mature gonads.

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