



## THE PHYSICAL OCEANOGRAPHIC ASSOCIATED WITH THE HABITAT OF SEA CUCUMBERS

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### KeyWords

*Actinopyga miliaris*, Biawak Island, Habitat of sea cucumbers, *Holothuria atra*, Java Sea, Oceanographic parameters, Sea cucumber, Spatial distribution, *Stichopus hermani*

### ABSTRACT

The Biawak Island is a small island in the Java Sea, which is located in the north of Indramayu, west java province. Biawak island has a high potency of sea cucumber. This study aims to study the relationship between the oceanographic aspects and the habitat of sea cucumbers, and also to create the spatial distribution of sea cucumbers maps in the Biawak Island Waters. The distribution of sea cucumbers is strongly influenced by the oceanographic parameters. The sea cucumbers occupy limited space and specific conditions for survival. Oceanographic studies on a continuous scale of timing and a space are needed to understand the characteristics of oceanographic conditions as a habitat of sea cucumbers. The waters of Biawak island have varying condition oceanographics with high potential sea cucumbers. There are 3 species of sea cucumber spread over the Biawak Island, namely *Holothuria atra* (87,3%), *Actinopyga miliaris* (7,2%), and *Stichopus hermani* (5,5%). The distribution of sea cucumbers varies spatially in the waters of Biawak island with the highest number found in the northeastern part of the biawak island with habitat characteristics in the form of substrate sand and coral sand. Oceanographic parameters affect the spatial distribution of sea cucumbers as limiting factor of sea cucumber habitat. Sea cucumbers are found at the temperature ranging from 28 – 31 °C, salinity ranging from 29,5 – 30 ppt, DO 1,5 – 3,0 mg/l and pH 6,4 – 6,5.

## Introduction

Biawak Island has another name that is the island of Rakit and Bonpies which is around the island of Gosong and Cendekia. Biawak islands are located in North Indramayu, West Java Province with a distance of about 40 nautical miles. This area by the local government has been set up as one of the area water conservation area (KKPD), but the data related to the existing resources in the area is still very minimal and not integrated with each other so the condition and status of marine resources on the Biawak Island and the surrounding sea has not been fully illustrated.

Research advance of the Biawak Islands already started in 2006 by doing much of their island zoning, year 2012 conducted an inventory of Oceanography (Purba et al, 2), the year 2013 done some research regarding the zoning (Pramana et al., 2013), Hendrayana et al. (2013) are reviewing about the fertility waters, Sudrajat (2011) and Khadafi (2013) examines the condition of the benthos. Next in 2012 and 2013 through BIEXRE I-TRAX II and performed the study of marine energy, the mass of water and coral cover. These studies are still partial where not all of the parameters and fields was discussed thoroughly.

The study emphasizes the study of measurement of the return on the aspects of Oceanography at multiple locations with emphasis on aquatic environments relation to the living conditions of sea cucumbers. Several surveys have been done visually found that in some places there are habitat of sea cucumbers, especially in the west and southwest (TRAX 2013; Pramana et al. 2011). Approximately, 58 species of Holothuroidea in the world are listed as the fisheries commodities (Conand and Muthiga 2007; Choo 2008; Purcell et al. 2012). Sea cucumbers are marine commodity that needs to be developed given the source of protein. Some of the processed products from sea cucumbers include sea cucumber crackers and are sold very expensive. Nutritionally, sea cucumbers have an remarkable profile of valuable nutrients such as Vitamin A, Vitamin B1 (thiamine), Vitamin B2 (riboflavin), Vitamin B3 (niacin), and minerals (Bordbar et al., 2011). Among the five existing classes of Echinoderms, it is the sea cucumbers that are both commercially fished and heavily overexploited (Kelly, 2005; Anderson et al., 2011). Sea cucumbers, belonging to the class Holothuroidea under the phylum Echinodermata, are usually occurred in the shallow benthic areas and deep seas across the world (Bordbar et al., 2011). They have high commercial value coupled with increasing global production and trade and therefore, commercially fished and heavily overexploited in some areas (Kelly, 2005; Bruckner et al., 2003). The widespread and growing interest in this commodity is indicative of strong market-based drivers to increase production of sea cucumber (Brown et al., 2010). It also shows that sea cucumbers provide an important contribution to economies and livelihoods of coastal communities, being the most economically important fishery and non-fish export in many countries (Toral-Granda et al., 2008).

In its habitat, sea cucumbers move very slowly and occupy a water column with a depth of 0.5-2 meters. Sea cucumbers are found on the sand substrate and the brightness reaches 100%. If you see the condition can be assumed that the location of this sea cucumber included in the micro-ecosystem system. Occupies a limited space and has specific conditions to live. Therefore, oceanographic studies on a continuous scale of space and time are needed to see the condition of suitable waters as the habitat of sea cucumbers.

## Methods

This research was carried out during August-November 2014 (4 months). Area of research is in the waters of Biawak Island, Indramayu, West Java province on the coordinate restriction 4-6 ° S and 106-110 ° E (Figure 1). Activity measurements of oceanographic parameters of the waters was carried out on 9-12 December 2014.

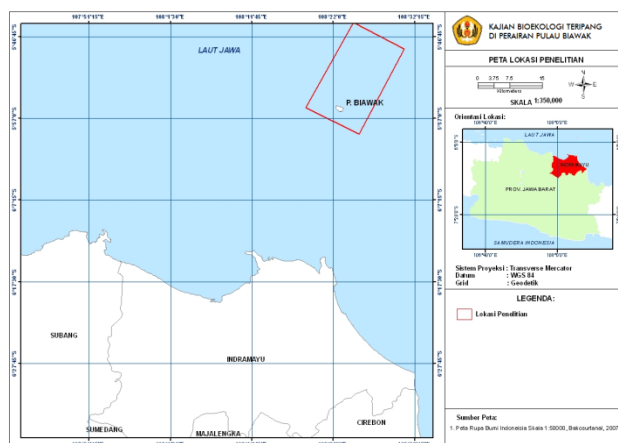


Figure 1. Study Area

## Data analysis

All oceanographic data in though using ArcGIS software, Matlab and Surfer with the result of a horizontal profile map of oceanographic parameters and oceanographic overlay parameters with spatial distribution of sea cucumbers in the waters of Biawak Island. The results of this study were analyzed descriptively by looking at the relationship between oceanographic parameters (temperature, salinity, DO and pH) and sea cucumber. Measurements are carried out in parallel with observations of sea cucumber movements in the morning, afternoon and evening. The survey was conducted in an integrated manner by looking at the previous results: Sudrajat et al., 2011; Pramana et al., 2013; BIEXRE I and II, 2012; TRAX 2013.

## Results and Discussion

Oceanographic Conditions in Biawak Island Waters. The result of measurement of oceanographic parameters that have been done include the measurement of physics parameters (temperature, salinity, current, tidal) and chemical parameters (pH, dissolved oxygen). In addition to oceanographic parameters, this study also observed sea cucumber species and sea cucumber habitat. Observations were made based on the location of the station as in Figure 2.



Figure 2. Location of Observation Station in the waters of Biawak Island

The criteria for selecting the location of the sea cucumber station were chosen based on different habitat characteristics, namely: (1). Closest to the mainland; (2). Beach shore; (3). The area of coral reefs is further from the shore. The total number of stations from all three zones is 43 stations.

The result of measurement of water level (in cm) in the waters of Biawak Island shows spatial variation of different values. In general, the eastern part of Biawak Island has a higher water level than the western part of Biawak Island (Figure 3).

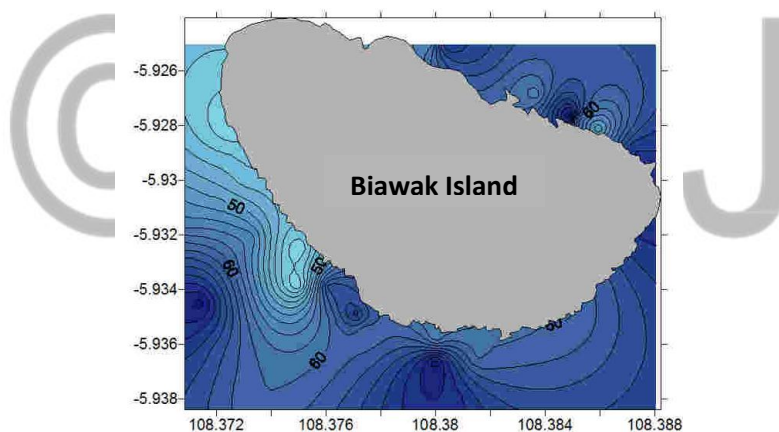


Figure 3. Horizontal Profile Water Level in Biawak Island Waters (cm)

The range of water level during observation is 40-70 cm with a minimum height (40 cm) on the northwestern of Biawak Island. The height of the water level on the beach reaches 40 cm because at the moment the observation is underway so that the entire coastal area is flooded by water. The pattern of tides in the waters of the island of Biawak is a mixture of the combined types of diurnal and semidiurnal pairs. Tidal patterns during October 2014 can be seen in Figure 4.

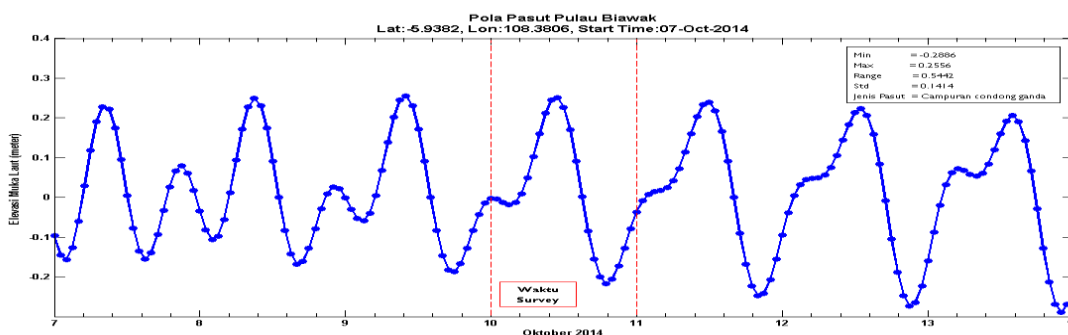


Figure 4. Tidal Pattern in Biawak Island Waters during October 2014

The horizontal distribution of temperature and salinity during observations shows differences in values around the Liaison Island Waters. The temperature in the western part of the island of Biawak is relatively warmer (30-32°C) than in the east (29-30°C). Similarly, salinity values in the western part of Biawak Island tend to be higher (29-33 ppt) than in the east (30-31 ppt) (Figure 5).

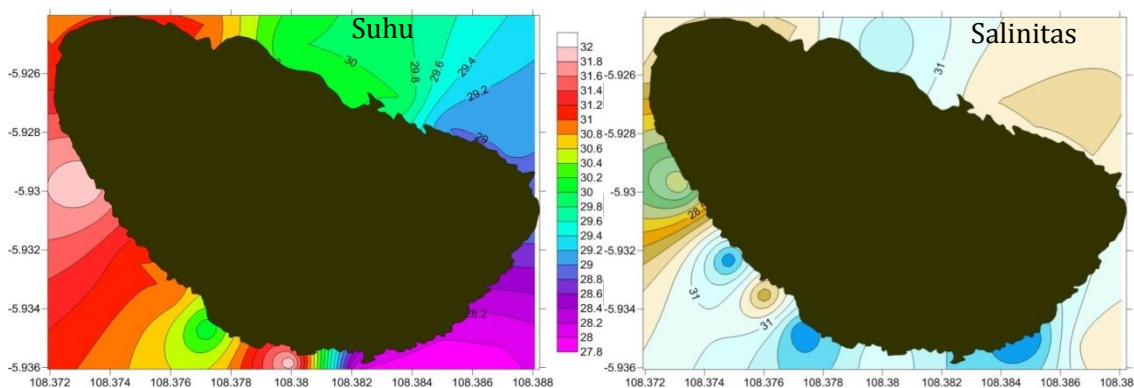


Figure 5. Distribusi Horizontal Suhu dan Salinitas pada tanggal 10-11 Oktober 2014 di Perairan Pulau Biawak

To find out the relationship between temperature and salinity to the abundance of sea cucumbers, a histogram analysis was carried out (Figure 6). This histogram shows the value of the temperature or salinity range (x axis) and frequency or number of sea cucumbers (y axis).

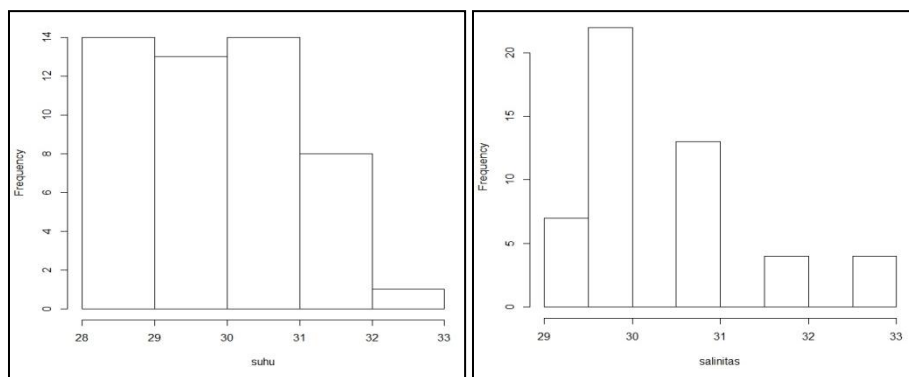


Figure 6. Histogram Hubungan Antara Suhu Dan Salinitas Terhadap Jumlah Teripang

The results of histogram analysis of the relationship between temperature and salinity to the abundance of sea cucumbers indicate that the abundance of sea cucumbers is related to a certain range of temperatures and salinity. Sea cucumbers are most commonly found in waters with a temperature range of 28-31°C and salinity 29.5-31 ppt.

Chemical oceanographic parameters measured in this study are dissolved oxygen or dissolved oxygen (DO) and pH. Dissolved oxygen indicates the amount of dissolved oxygen in the water. The main source of oxygen in the waters is the result of diffusion from the air, carried through precipitation and photosynthetic results of phytoplankton. The low content of dissolved oxygen can adversely affect marine biota. Horizontal distribution of DO and pH content can be seen in Figure 7.

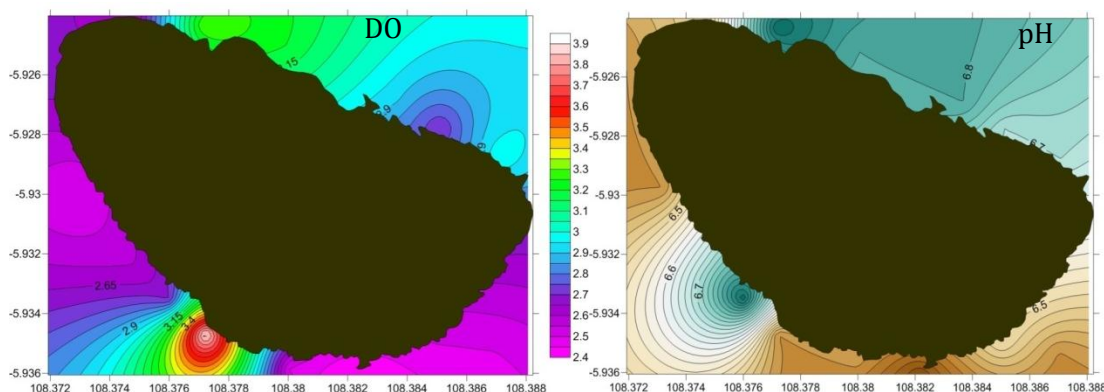


Figure 7. Horizontal Dissolved Oxygen (DO) Distribution and pH for 10-11 October 2014 in Biawak Island Waters

The research results of marine chemical parameters showed the DO value varies with the range of 2.4-4 mg / l. DO values in Biawak Island waters are classified as unpolluted according to Government Regulation No. 82 of 2001 concerning water quality management and water pollution control which confirms that the minimum DO level that must be present in water is  $> 2$  mg / l. The highest DO value is in the southwest, which is 4 mg / l and the lowest is 2.4 mg / l in the southeast part of Biawak Island. The degree of acidity (pH) is a measure of hydrogen ion concentration and shows the atmosphere of the water whether it can react with acids or bases. The pH value of marine waters is influenced by several factors including photosynthesis activity, biological activity and oxygen content. The pH value during the study showed that relatively homogeneous values ranged from 6.3-6.9, this was included in the criteria for good waters for sea cucumber cultivation. The relationship between abundance of sea cucumber with DO and pH parameters can be seen in Figure 8. Results of histogram analysis showed the highest sea cucumber frequency found in waters with a range of DO 1.5-3 mg / l and pH 6.4-6.5. Sea cucumber in the smallest amount found in DO  $< 1.5$  mg / l.

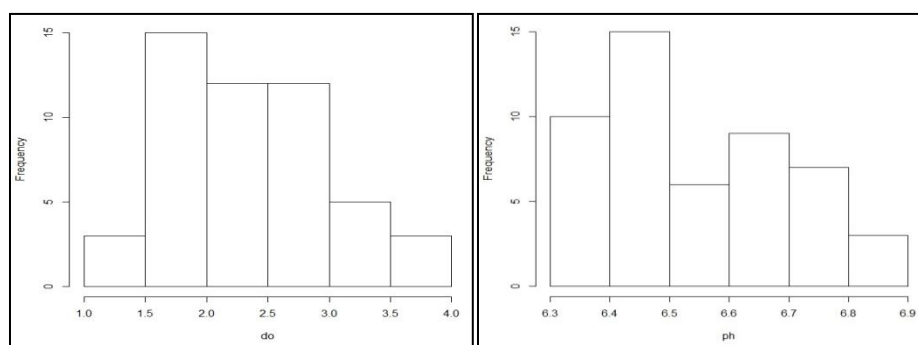


Figure 8. Histogram of relationship between DO parameters and pH on the abundance of sea cucumbers

### Spatial Distribution of Sea Cucumbers in The Biawak Island Waters

Mapping the spatial distribution of sea cucumbers depicts the presence of sea cucumbers with a certain amount on the station that has been determined. Based on observations, 3 species of sea cucumber were found in Biawak Island waters, namely *Holothuria atra*, *Actinopyga miliaris* and *Stichopus hermani*. Sea cucumbers are found to be solitary and clustered (3-10 individuals), this is consistent with Martoyo et al. (1994) in Radjab (2003). The dominant species of sea cucumber in Biawak Island Waters is *Holothuria atra* as much as 87,3%. Other sea cucumber species were found in relatively small amounts, namely *Actinophyga miliaris* (7,2%) and *Stichopus hermani* (5,5). The types of sea cucumber found is classified in the order Aspidochirotida. The Aspidochirotida order is a characteristic that lives in clear tropical waters. Yusron (2007) in Hyman (1955) suggests that the Indo-Pacific region of the west is an area rich in the types of sea cucumbers *Holothuria*, *Stichopus* dan *Actinopyga*. Sea cucumbers (Holothuroidea: Echinodermata) are found in various substrates and depths (Sluiter 1901; Samyn et al. 2006; Woo et al. 2013). cucumbers prefer harder substrate, such as sand, rocks and dead coral related to their locomotion. Based on this study, approximately 71.4% species of Holothuroidea (family Chiridotidae, Stichopodidae, and some species of Holothuroiidae) was found at under rocks around the reef. Purwati and Wirawati (2012) also reported in Prigi Bay, six species of sea cucumbers (*H. atra*, *H. erinaceus*, *H. mactanensis*, *Afrocucumis africana*, *Chiridota* sp., and *Polycheira rufescens*) were found at under rock and some individuals in sand-boulders.

*Holothuria atra* is one type of sea cucumber that naturally has the ability to breed asexually. This ability can be used to multiply the number of individuals to increase the population. The number of sea cucumbers found during the observation was 165 sea cucumbers spatially spread to the south, west and east of Biawak Island. Map overlay the spatial distribution of sea cucumbers according to the amount with the water level height contour can be seen in Figure 9.

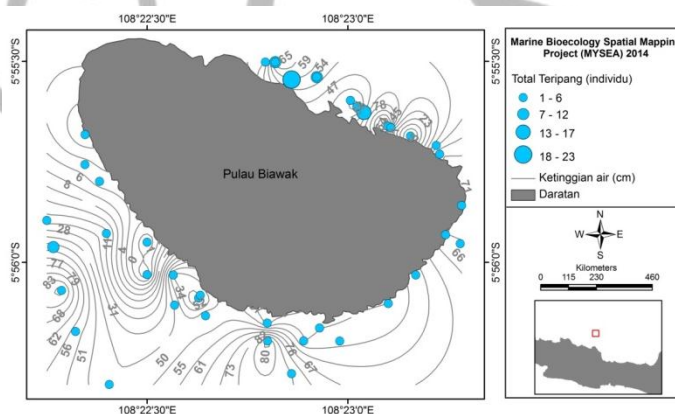


Figure 9. Spatial Distribution Sea Cucumber and Water Front Height Contour (cm) in Biawak Island Waters

The number of sea cucumbers varies spatially with more numbers found in the northeastern part of Biawak Island (1-23 individuals). In general, eastern waters are clearer than the western part of Biawak Island. This is related to the type of substrate where the eastern part is dominated by sand and coral while the western part of the substrate is mud so that the water is brownish and causes less sea cucumbers.

The size of sea cucumbers found is quite varied from small to large with a length of 10-25 cm. Sea cucumbers are found during low tide conditions and are more difficult to find during high tide. Sea cucumbers are found starting from shallow tidal areas with sand, muddy sand and rubble. Sea cucumbers are not found in locations on the coastline station and further away from the coastline. This is due to the relatively high current conditions not suitable as sea cucumber habitat. This statement is supported by the results of research that states sea cucumbers live in clear and calm waters (Radjab, 2003).

To find out the relationship between temperature and sea cucumbers spatially, an overlay of the temperature and position of sea cucumbers was carried out at each station (Figure 10).

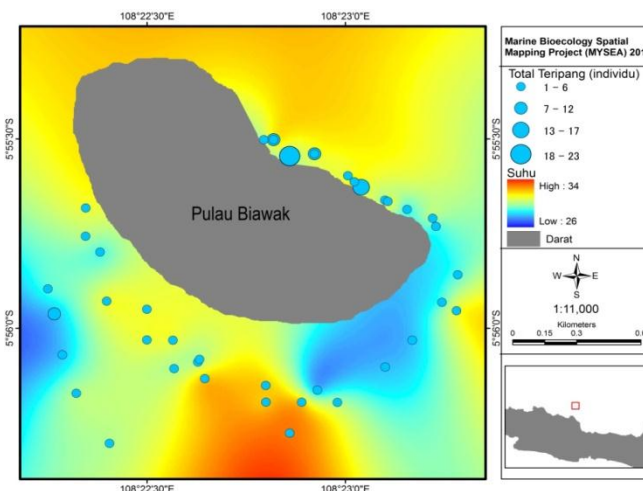


Figure 10. Spatial Distribution of Sea Cucumber and Temperature in Biawak Island

Spatial distribution of sea cucumbers was found to spread in a temperature range of 28-33°C, but more found in waters with relatively cold to warm temperatures in the range of 28-31°C. In the southern part of Biawak Island, the water temperature is warmer at 32-33 32C and relatively small amounts of sea cucumbers are found (1-6 individuals). The spatial distribution overlay map of sea cucumbers with salinity can be seen in Figure 11.

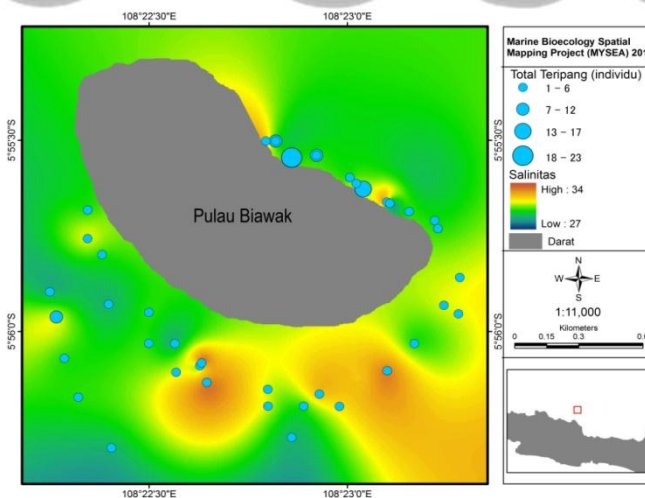


Figure 11. Spatial Distribution of Sea Cucumber and Salinity in Biawak Island Waters

Based on the spatial distribution overlay map of sea cucumbers with salinity in the waters of Biawak Island, it was seen that many sea cucumbers were scattered (7-23 individuals) in waters with relatively low salinity of 29.5-31 ppt. In locations with the highest salinity value of 33 ppt found fewer sea cucumbers (1-6 individuals).

In general, sea cucumber habitat is very determined by a certain range of each oceanographic parameter as previously explained. This information is important in the assessment of suitable location for the cultivation of sea cucumbers.



## Conclusion

Biawak Island waters have varied oceanographic conditions with potential sea cucumbers that have not been used optimally. There are 3 species of sea cucumber which are scattered in the waters of Biawak Island namely *Holothuria atra*, *Actinopyga miliaris* and *Stichopus hermani* with the dominant species namely 87.8% of *Holothuria atra*. Sea cucumber distribution varies spatially in Biawak Island waters with the highest number found in the northeastern part of Biawak Island with habitat characteristics (substrate type) in the form of sand and coral sand substrate. In addition to the type of substrate, the high number of sea cucumbers in the northeastern waters of Biawak Island is also supported by oceanographic conditions that correspond to the optimum range of sea cucumber habitat. Oceanographic parameters affect the spatial distribution of sea cucumbers as a limiting factor of sea cucumber habitat. Sea cucumbers are found in temperatures with a range of 28-31°C, relatively low salinity of 29.5-30 ppt, DO 1.5-3.0 mg / l and pH 6.4-6.5.

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