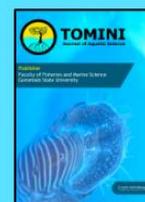




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Density of the blue-black urchin *Echinotrix diadema* (Linnaeus, 1758) in Tomini Bay, Indonesia

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ABSTRACT

The blue-black urchin has been widely known and utilized as food in the world, including Indonesia, because sea urchin gonad can be consumed. However, the utilization of sea urchins in Gorontalo has not been performed. On the other hand, natural resources information is needed as the database for natural resources management in Tomini Bay. The aim of this study is to document the blue-black urchin *Echinotrix diadema*. This study conducted at Blue Marlin Beach, South Leato, Gorontalo, from November 2019 to January 2020. Sea urchin density was calculated with a 1 m × 1 m transect quadrat that positioned at interval 5 m in distance along 15 m of the transect line at the coral reef ecosystem. In parallel with the measurement of the density, sea urchin test diameter was measured with a Vernier caliper (0.01 mm accuracy), and the water temperature was measured with a thermometer. The results show that the average of sea urchin density is 3 ind. m⁻² in November and December and 1 ind. m⁻² in January. That density has no significant difference among the month. Moreover, the average size of the sea urchin test diameter is 60 mm in November, 63 mm in December, and 66 mm in January. The seawater temperature is 34 °C in November, 37 °C in December, and 33 °C in January. That results show that sea urchin density in the blue marlin beach is very low.



INTRODUCTION

Tomini Bay is a very potential area for the development of business in fisheries resources (Natsir et al., 2017) because it is the largest bay in the equatorial region (Sulaeman et al., 2018) and originally rich on marine resources (Obie, 2018). Tomini bay has also been known as the most productive area in the northern Sulawesi. Amri et al. (2017) reported that Tomini Bay has a high fish production, and it produced enormous natural resources. That high fish production mainly supported by three productive ecosystems, such as coral reef, mangrove, and seagrass, that produce a significant number of fisheries products.

A lot of fisheries products, either pelagic or demersal fish, has been caught at Tomini bay. However, the catch reports are still dominated by pelagic fish such as yellowfin tuna (Mardlijah

& Rahmat, 2012), cuttlefish (Jula et al., 2018; Suwarso et al., 2017), mackerel (Amri et al., 2017) and Nike-fish (Djamil, 2020). A study on pelagic fish has also been documented abundantly in the waters of Tomini Bay (Badrudin et al., 1992). However, Awwaluddin and Rustam (2017) revealed that demersal fish such as grouper, snapper, and lethrinus are also a fisheries products that potential in Tomini Bay.

Information on sea urchins as a fisheries potential in Tomini Bay is still undocumented in well. Only one study that reported by Baruadi et al., in 2017, has discussed the density and distribution of sea urchin in Tomini bay. Meanwhile, in other places, a study on sea urchin has been widely reported. Even sea urchins have been utilized and fished in the large number because sea urchins are essential fishery commodity that its eggs are consumed (Amarowicz et al., 2012; Suriani et al., 2020), either in fresh (Nane, 2019) or cooked (Rodriguez et al., 2007). Moreover, Sea urchin gonad is considered because it has a high commercial value and the delicacy of its gonad (Takagi et al., 2019), and its gonad contains essential amino acids (De la Cruz-García et al., 2000). In Japan, the price of sea urchin gonad is 10000 JPY kg⁻¹ (Reynolds & Wilen, 2000). The utilization of sea urchins in Indonesia, particularly in Wakatobi Island, has been overexploited (Nane & Paramata, 2020). On the other hand, FAO (2016) has reported that sea urchin catch had declined worldwide from 108,969 tons in 1995 to 76,467 tons in 2014. Unfortunately, the utilization of sea urchins in Gorontalo has not been documented. As a consequence, information on a sea urchin is lacking.

It is crucial to document bio-ecological information of blue-black urchin *Echinotrix diadema*, particularly on its density. That data is not only crucial for sea urchin management but also for the protection of genetic resources. Therefore, this study will try to document one of the important species of sea urchin *E. diadema* that settled in the coral reef ecosystem. The objective of this study was to document the density of blue-black urchin *E. diadema* at Blue Marlin Beach, South Leato, Gorontalo Bay, Indonesia. This information can be used as a database for sea urchin management and genetic conservation in the future.

MATERIAL AND METHODS

Study site. This study was conducted at Blue Marlin Beach, South Leato, Gorontalo Bay, Indonesia (Figure 1), from November 2019 to January 2020. Sea bottom substrate was dominated by the coral reef where sea urchin settled. This study site was selected purposively according to the presence of the blue-black urchin *E. diadema* at the coral reef ecosystem.



Figure 1. Study site. The red dot (●) indicates the location of sea urchin sampling at Blue Marlin Beach (0°29'37.3"N 123°04'24.0"E), Tomini Bay, Indonesia.

Sea urchin density (ind. m⁻²). The density of the blue-black sea urchin was calculated in situ (field experiment) by using a 1 m × 1 m transect quadrat along a 15 m transect line where the quadrat positioned at each interval 5 m (in total three quadrates along the lines). Then, individuals of sea urchins at each quadrat was counted and noted on the aqua note. In parallel with the measurement of sea urchin density, all specimens that occurred in a quadrat were collected with a net bucket for test diameter measurement. Then, the test

diameter was measured by a Vernier caliper (0.01 mm in accuracy). Furthermore, all specimens that have been measured were released to the sea. Seawater temperature was recorded with a thermometer.

All statistical analyses were conducted using JMP (SAS Institute Inc., Cary, NC, USA). Significant difference among month on sea urchin density and test diameter size was performed with One-way ANOVA that significant at $p < 0.05$.

RESULTS AND DISCUSSION

Blue-black urchin *E. diadema* commonly settled on the coral reef ecosystem within a small group (ca. 1–6 individuals). Sea urchin settled in the crevices of coral reef at 2–5 m in depth and distributed randomly at the coral reef ecosystem. The distribution of sea urchins is commonly affected by the availability of a reef cavity for settlement and food availability.

Sea urchin density. Figure 3 shows that there is no significant difference in the density of sea urchin *E. diadema* among November and December, with a monthly average of the density is 3 ind. m^{-2} . Conversely, the average of sea urchin density in January 2020 is 1 ind. m^{-2} and it has a significant difference ($p < 0.05$) with the density of sea urchin in November and December 2019. That shows sea urchin density at Blue marlin is < 5 ind. m^{-2} which means the density of sea urchin is very low according to the categorization of urchin density that provides by Palaćin et al. (1998). Sea urchins can reach as high as 80–120 urchins m^{-2} (Grisolía et al., 2012; Kriegisch et al., 2016) on coral reefs when the density is overabundant.

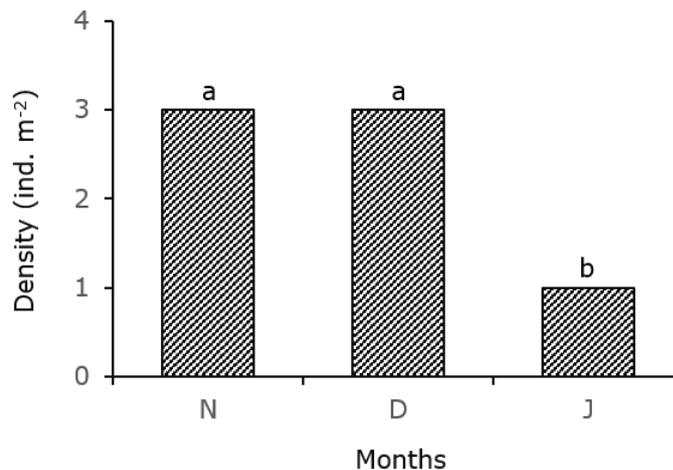


Figure 2. The density of the blue-black urchin *Echonoatrix diadema*.

Moreover, decreasing sea urchin density in January 2020 may have been affected by fishing activity, as the study site is a free zone for fishing activity. As a consequence, it is likely the specimens have been collected by the fishermen. Although the local fishers who live around the study area have not consumed sea urchin gonad, however, some recreational fishers from Buton and Muna tribe sometimes come to the Blue Marlin Beach and collected sea urchins. Sea urchin fishing has been reported that could reduce the number of sea urchins. Moreover, Nane and Paramata (2020) reported that high fishing activity in Wakatobi island had overfished sea urchins.

Test diameter. Figure 4 shows the average test diameter of sea urchin among months have no significant differences. The average test diameter of the blue-black urchin *E. diadema* is 60 mm in November, 63 mm in December, and 66 mm in January, respectively. Dumont et al. (2006) have characterized sea urchin by the size as a juvenile (10–15 mm in diameter), small adults (15–20 mm), and large adults (> 25 –70 mm). The test diameter size of sea urchins among months has no significant difference. It may reflect that the growth of sea urchin body size is

slowly and may affect by food availability in the crevices around the coral reef ecosystem. The previous study has reported that food selection of sea urchins was determined by the nutrient content of foods (Meyer et al., 2007; Rocha et al., 2019; Tomas et al., 2015).

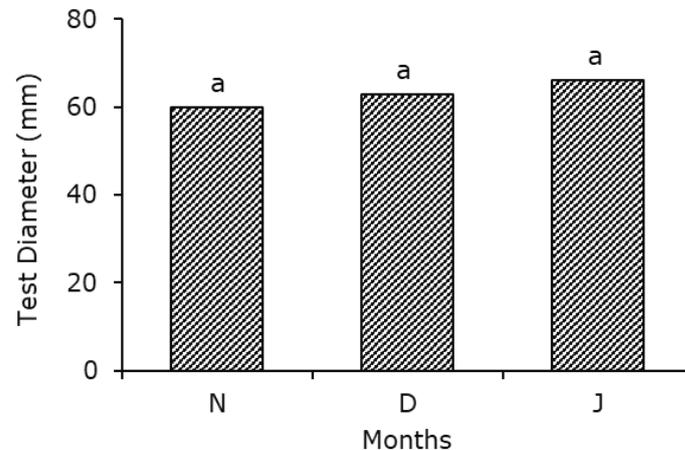


Figure 3. Sea urchin test diameter *Echinotrix diadema*. The same letter above the bar indicate no significant difference in size.

Seawater temperature. The seawater temperature recorded is 34 °C in November, 37 °C in December, and 33 °C in January. The changes in water temperatures reflect the monthly changing of seawater temperature and has no impact on the activity of invertebrates (Cossins & Bowler, 1987). The previous study reveals that a movement of sea urchins was not affected by temperature (Lauzon-Guay & Scheibling, 2007). However, the density of sea urchins is affected by predation activity (Hereu et al., 2005; Medrano et al., 2019; Sala & Zabala, 1996).

CONCLUSION

Blue-black sea urchin *Echinotrix diadema* settled in a cavity of coral reef ecosystem at 2–5 m in-depth with the temperature range is 33–34 °C. The average of blue-black urchin density that was recorded at the Blue Marlin beach is 1 to 3 ind. m⁻² with the average of test diameter is 60 mm in November, 63 mm in December, and 66 mm in January. That results show that blue-black urchin density in the blue marlin beach is very low, and the temperature may not impact the density of sea urchin.

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