STUDY ON THE HABITAT PREFERENCE OF *Diadema setosum* IN BAMA COAST BALURAN NATIONAL PARK

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ABSTRACT

Diadema setosum *is an ecologically important sea urchin which is exists on Bama Coast, but there is no report about the presence of* ***D. setosum*** *in Bama Coast yet. This study was done in order to know the habitat type occurs in Bama Coast, the presence status of* ***D. setosum****, distribution pattern, the habitat preference and the character of habitat which is preferred by* ***D. setosum*** *in Bama Coast. Quadrate transect method was used to collect the data. Eight line transect was positioned parallel to the shore line. The transect line was 160 m in length and placed 30 m distance between transects. Quadrate plots of 1 × 1 m² placed 4 m distance from each plot along the transect. The habitat type was defined by estimated the dominant benthic cover of each plot. Measurement of physical and chemical factor of water includes sea water temperature and salinity. The Distribution pattern was determined by Poisson distribution and Chi-square simultaneously, then continued using Green coefficient, the habitat preference was analyzed by Chi-square and the character of habitat which is preferred by* ***D. setosum*** *was analyzed by selection index. The result of this study shows that there are five habitat types in Bama Coast, which are sand, rubble, seagrass, live coral and dead coral. The distribution pattern of* ***D. setosum*** *in Bama Coast is clumped and only presence in three habitat types, which are seagrass, live coral and dead coral. Dadema setosum prefers several habitat type, which are dead coral and live coral and the character of habitat which is preferred by* ***D. setosum*** *is hard and solid substratum with simple architecturally structure.*

Key words: Diadema setosum*, habitat type, Bama Coast, habitat preference*

INTRODUCTION

Baluran National Park is a protected area for ecological conservation which is located in Situbondo, East Java. This National Park has several recreation objects, but the most visited one is Bama Baech area (Anonym, 2007). This beach is not only has beautiful beach scenery, but also has a high diversity of the sea creatures in its coastal area. Marine Invertebrates that can be found in Bama Coast are Porifera, Cnidarians, Mollusca, Arthropods and Echinoderms (Anonym, 2010). The Echinoderms that presence in Bama Coast was reported by Minarputri *et al.* (2012), but the identification restricted to the order level. This research was more detail since it exposed Echinoderms to the species level and the topic that will be discuss is the habitat preference of *Diadema setosum*, the sea urchin.

D. setosum is one of Echinoderm that can be found in Bama Coast (Anonym, 2010). *D. setosum* is widely spread on the Indo-Pacific Ocean (Nader and Indary, 2011). This sea urchin can live in many kinds of habitat, but generally an organism has a habitat preference. It means that an organism will choose the habitat which they mostly like, so the highest number of individual will be found in their preferred habitat (Krausman, 1999). *D. setosum* is ecologically important animal. They have many ecological functions, such as algal grazer in coral reef ecosystem (Siringoringo and Djuwariah, 2010) and can also be used as bioindicator for heavy metal contamination in seawater (Rumahlatu, 2011). However, *D. setosum* is also a dangerous animal, it has long and sharp needle-like spines that can easily penetrate the human skin and the calcareous spines fragments almost impossible to remove from the skin. Sometimes an infection wound appear as the consequence of the microscopic organism from the *Diadema* spines (Lerman, 1986). The sharp needle-like spine is not only danger for human, but also has negative impact on hard coral, which can cause bioerosion of hard coral on a coral reef ecosystem (Ruengsawang and Yeemin, 2000).

Based on those important functions of *D. setosum,* this research was done in order to know the habitat type occurs in Bama Coast, the presence status of *D. setosum*, their distribution pattern, the habitat preference and the character of habitat which is preferred by *D. setosum* in Bama Coast. The presence of *D. setosum* in Bama Coast is important to known by researcher or by everybody who wants to find this sea urchin in their real habitat, so people can easily found them and be more careful on the area which is preferred by of *D. setosum*.

METHOD

Data collection was carried out twice (August 28th–September 3rd and October 17th–19th 2012) in Bama Coast, while the data analysis was carried out in the Ecological Laboratory, Faculty of Science and Technology, Airlangga University.

Quadrate transect method was used to collect the data of the habitat type, the substrate composition and the presence of *D. setosum*. Eight line transects, 160 m each line, was positioned parallel to the shoreline with the distance between the line transect was 30 m. The line transects were placed parallel to the shoreline in order to completing the data about substrate composition and benthic cover condition that wasn't covered by Minarputri *et al.* (2012) which used a line transect perpendicular to the shoreline at the same location. Quadrate plots of 1 × 1 m^2 were placed along the line transect with 4 m distance from each plot.

Characterization of habitat type on each plot was based on the dominant benthic cover of the plot. The percentage cover of seagrass was estimated using seagrass percentage cover photo guide by Short *et al.* (2006). Seagrass said to be dominant if the percentage cover of seagrass on a plot is more than 5%. While the percentage of coral cover was calculated based on the wide of coral which covering the plot. Life coral or dead coral said to be dominant if the percentage cover in a plot is higher than 24,9%. If the benthic covers in a quadrate plot consist of seagrass and coral, then the habitat type was determined by the percentage of the more dominant benthic covering. But if the seagrass or coral were not seems to be dominant in the quadrate plot, then the habitat type determination is based on the dominant substrate composition. Data collection was carried out during the low tides, but in the area which the benthic cover condition was seems to be dominated by coral, data collection was carried out during the high tide in order to avoid disturbing the corals.

Measurement of physical and chemical factor of water includes temperature and salinity of seawater. The distribution pattern of *D. setosum* examined using Poisson distribution and Chi-square test (Schefler, 1987) to determine the randomness, then continued using the Green coefficients (1).

$$\text{Green coefficient} = \frac{(s^2/x) \quad 1}{(x) \quad 1} \qquad (1)$$

(s^2 = variance $\left(\frac{ss}{df}\right)$; ss = sum of square; df = degree of freedom; $\bar{x}$ = average number of *D. setosum* each plot; Σ(x) = total number of *D. setosum* of the whole plots). Positive values of the Green coefficient showed clumped pattern, while a negative value indicates a uniform pattern (Krebs, 1999).

Habitat preference was analyzed by Chi-square test (Hariyanto *et al.*, 2008) and the character of habitat which preferred by *D. setosum* was analyzed using standardized selection index (2). Value of standardized selection index of a habitat type bigger than 1/n (n: number of habitat type) indicate there is a preference on those habitat type (Krebs, 1999).

$$w_i = \frac{o_i}{p_i}, \qquad B_i = \frac{w_i}{\sum_{i\ 1}^{n} w_i} \qquad (2)$$

(w_i = selection index; B_i = standardized selection index; o_i = proportion of *D. setosum* on *i* – habitat type; p_i = proportion of *i* – habitat type available on location)

RESULTS

The seawater temperature of Bama Coast ranged from 28 to 30° C and the seawater salinity ranged from 30–35‰. The substrate composition given in the Figure 1, shows that

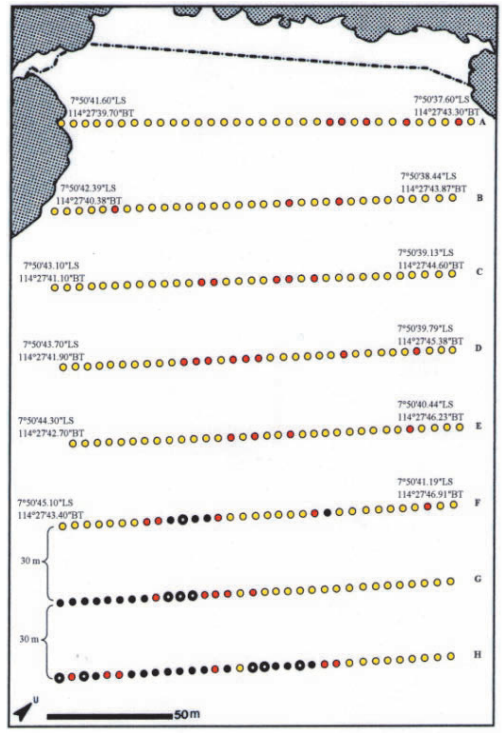

Figure 1. Map of benthic substrate on Bama Coast. Coordinate shows the beginning and the end point of sampling position; (A-H) transect line; (▒) vegetation; (—) highest tide limit; (●) sand; (●) gravel; (●) rubble; (●) fully covered by coral.

benthic area of Bama Coast was dominated by sand, while the benthic cover of Bama Coast was dominated by seagrass (Figure 2). In Bama Coast there were 5 habitat types, i.g. rubble, seagrass, life coral and dead coral. Seagrass habitat type can be found in all transect lines, while the coral habitat type can only be found in transect F to H (approximately 180 to 240 m from the highest tide line).

D. setosum in Bama Coast can only be found on 3 habitat types, i.g. seagrass, live coral and dead coral, as shown in the Figure 2. Total number of *D. setosum* found were 24 individuals with 8 individuals on seagrass, 7 individuals on live coral and 9 individuals on dead coral habitat type.

Although *D. setosum* present in the same habitat type, actually they found at a different microhabitat. From 8 individuals that were found in seagrass habitat type, 7 of them were found in the microhabitat of dead coral crevices and 1 individual was found among the seagrass with sand substrate. As for the 7 individuals of *D. setosum* that were present in live coral habitat type, 5 of them were located on the microhabitat massive coral and the other 2 were in sub-massive coral.

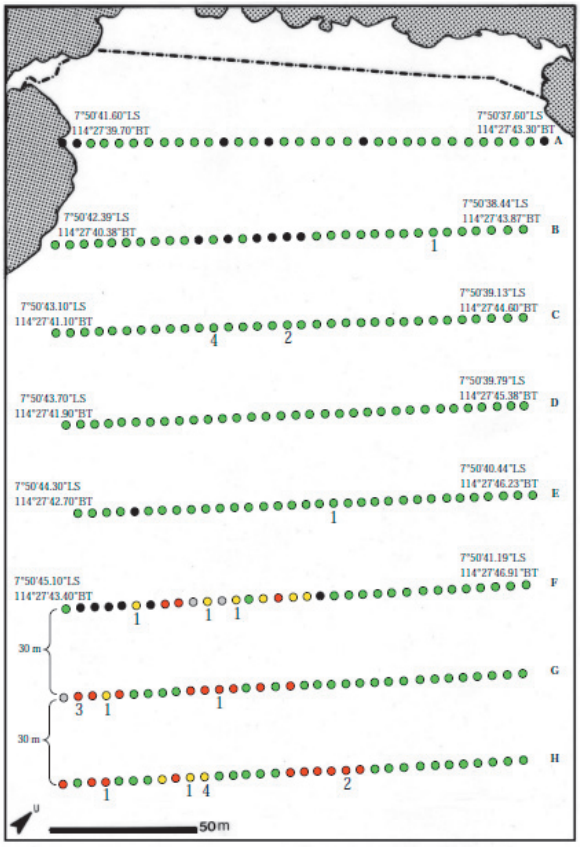

Figure 2. Map of *D. setosum* presence in several habitat types occurs in Bama Coast. Coordinate shows the beginning and the end point of sampling position; (A-H) transect line; (▭) vegetation; (▭) highest tide limit; (●) seagrass; (●) sand; (○) rubble; (●) live coral; (●) dead coral; (number) number of *D. setosum*.

The analyzed using Poisson's Distribution and Chi-square test shows that *D. setosum* didn't spread randomly (χ^2_{count} of 6.097,6 > $\chi^2_{(0,05;\,4)}$ of 9,488). The value of Green coefficient was 0,059, it means that *D. setosum* in Bama Coast has a clumped pattern. The Chi-square analyzed based on the data given on Table 1 shows that there was a preference of *D. setosum* in some habitat type (χ^2_{count} of 92,86 > $\chi^2_{(0,05;\,4)}$ of 9,488).

Standardized selection index value of each habitat type given on Table 2 shows that *D. setosum* has a preference in live and dead coral habitat types. In the live coral habitat types, *D. setosum* can be found on 2 kind of coral life-forms, which were massive coral and sub-massive coral. Selection index value for each coral life-form (Table 3) shows that *D. setosum* preferred massive coral as the microhabitat, than the life-form of sub-massive corals.

Table 1. Presence of *D. setosum* in five habitat types occurs in Bama Coast

Habitat type	Habitat availability on the study area (%)	Number of D. setosum	
		Expected	Observed
Sand	7,2	1,73	0
Rubble	1,14	0,27	0
Seagrass	79,54	19,09	8
Life coral	8,33	2	7
Dead coral	3,79	0,91	9
Total	100	24	24

Table 2. Selection index of *D. setosum* in five habitat types occurs in Bama Coast

Tipe habitat	Habitat availability (pi)	Number of D. setosum (ui)	Proportion of D. setosum on habitat type (oi)	Selection index (wi)	Standar-dized selection index (Bi)
Sand	0,072	0	0	0	0
Rubble	0,0114	0	0	0	0
Seagrass	0,7954	7	0,333	0,419	0,03
Live coral	0,0833	8	0,292	3,505	0,254*
Dead coral	0,0379	9	0,375	9,89	0,716*
Total	1	24	1	13,814	0,999

* Standardized selection index value more than (1/number of habitat type) or more than 0,2 in this case, shows preference.

Table 3. Selection index of *D. setosum* in two microhabitats types on live coral habitat

Micro-habitat type	Habitat avai-lability (pi)	Number of D. setosum (ui)	Proportion of D. setosum on micro-habitat type (oi)	Selection index (wi)	Standar-dized selection index (Bi)
Sub-massive coral	0,8182	2	0,286	0,35	0,08
Massive coral	0,1818	5	0,714	3,93	0,92*
Total	1	7	1	4,28	1

* Standardized selection index value more than (1/number of habitat type) or more than 0,5 in this case, shows preference.

DISSCUSION

The temperature and salinity of Bama seawater is still in the normal value of seawater condition with temperature ranged from 28 to 31° C (Nontji, 2002) and the salinity ranged from 17 to 38‰ (McConnaughey and Zottoli, 1983). The benthic cover of Bama Coast is dominated by seagrass and it occurs in all line transect (approximately 30-240 m from the highest tide), because seagrass can live in all types of substrate (Dahuri, 2003). Coral can only be found approximately 180–240 m from the highest tide, where the coarse substrate (rubble) was found, because the reproduction of coral requires hard substratum for the planula (coral larvae) attachment (Lailli and Parsons, 1993).

D. setosum in Bama Coast present in dead coral, live coral and seagrass with remnants of dead coral, it's due to Aziz (1995), whose said that habitat of rock-boring sea urchin, including genus of *Diadema*, isn't limited to the coral reefs and rocky shore, but also can be found in seagrass habitat type with remnants of dead coral colonies or stones.

The analyzed result shows that *D. setosum* in Bama Coast preferred in some habitat types, which were dead coral and live coral colonies. It's due to Aziz (1995), whose said that genus *Diadema* will spend most of their life hiding in a crevices that is usually found on living coral colonies, colonies of dead coral and stones. Habitat preference is most strikingly observed when animals spend a high proportion of time in habitats that are not very abundant on the landscape (Krausman, 1999). If there is no preference, then the higher proportion of *D. setosum* in Bama Coast should be found in seagrass habitat type, because seagrass habitat type has the greatest habitat availability percentage on the study area.

The analyzed of microhabitat preference on live coral colonies shows that massive coral was preferred by *D. setosum* because massive coral is hard and solid substratum with simple architecturally structure and *D. setosum* was seems to avoid the sub-massive coral because sub-massive coral has more intricate architecture structure. This is in accordance with the opinion of Dumas *et al.* (2007) as cited by Szabo and Anderson (2012) which state that *D. setosum* tend to avoid fine sediments, such as fine sand or mud, and tends to shun more architecturally intricate substrates such as areas of complex or branching coral cover.

D. setosum in Bama Coast has clumped distribution pattern. Those clumped behavior is the reason of an organism in order to protect themselves from their predator and to facilitate the fertilization (Nontji, 2002). Nontji (2002) also said that a group of *D. setosum* might consist of 20 to hundreds of individual.

Based on the result of this research, there is some suggestion for Baluran National Park, Resort Bama particularly for monitoring the presence of *D. setosum* in Bama Coast regularly and for all visitors of Bama Coast should be more careful in areas of coral reefs, especially dead coral. In addition, further research needs to be done about the habitat preferences of *D. setosum* by adding variables such as the food availability and the presence of predators in order to describe the habitat preferences more complete.

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