ECHINODERMATA, *Holothuria atra*, IN AN INTERTIDAL SEAGRASS BED OFF THE BAMA BEACH, BALURAN NATIONAL PARK, EAST JAVA, INDONESIA

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ABSTRACT

The occurrence of sea cucumber, *Holothuria atra,* was assessed in the seagrass area of the Bama beach, Baluran National Park in East Java. The study investigated the frequency and early stages of seagrass association preference of *H. atra*. Survey was conducted in May 2011 using belt transect (1m x 100m with three replicates). Frequency of *H. atra* and their association with seagrass were recorded. Furthermore, length and wet weight of each individual of *H. atra* were measured. The total of 146 individuals of *H. atra* were observed in which 37.67% associated with *Enhalus acoroides* (EA), 23.29% associated with *Cymodocea rotundata* (CR), 23,29% associated with mixed seagrass species of *E. acoroides* and *C. rotundata,* and 15.75% associated with no seagrass habitats. The results suggested that small size *H. atra* might prefer to live under the taller seagrass stands such *E. acoroides*, which could be morphologically benefits the *H. atra* by providing better protection and shelter area.

Keywords: *Holothuria atra*, *Enhalus acoroides*, *Cymodocea rotundata*, Baluran National Park.

I. INTRODUCTION

Baluran National Park is one of the Indonesia's National Parks located in Situbondo Regency at the northeastern tip of east Java. The Park is bordered by the Madura Strait in the north, the Bali Strait in the east, the Bajulwati River in the west, and the Klokoran River in the south (Figure 1). The park area is dominated by savana vegetation and forest. Along the coastline, irregular embayments, peninsulas, reefs, sandbanks, mudflats, mangroves, and swamp forests were also found. The seagrass communities off the Baluran are generally found near beaches where the waves are less strong (Anonymous, 2012).

Geographically, *Holothuria atra* is the most abundant sea cucumber species in Indo-Pacific region (Bakus, 1973; Rowe and Doty, 1977; Aziz, 1995; Massin, 1996). It is not only common on sandy beach but also at any type of substrate and coral reef ecosystem (Aziz, 1995). Their color in general is black and usually its body covered with sands (Bakus, 1973; Rowe and Doty, 1977; Aziz, 1995). It has been suggested that sand reflected light enabled *H. atra* to have a slightly lower body temperature (Aziz, 1995). Just like other sea cucumber, *H. atra* is an omnivore, consuming detritus, uneaten food, and algae in the substrate. It ingests sand grains, digests the nutrient, and then expels sand pellets both in day and night time (Bakus, 1973; Anonymous, 2011).

Sea cucumber not only play an important ecological role, but some species also economically importance. Due to its economical value, sea cucumber exploitation tends to increase nationally and internationally. The numbers of countries involving in sea cucumber exploitation and trading become doubled during the last two decades (Setyastuti, 2013). This tendency making sea cucumber in highly risk of overexploitation and depletion (Bruckner *et al*., 2003; Tuwo, 2004; Purwati and Yusron, 2005; Choo, 2008; Purwati *et al*., 2010; Purcell *et al*., 2011; Setyastuti, 2013). This condition can endanger the sustainability of sea cucumber since the recovery of its heavily exploited stocks is slow and sporadic (Kinch, 2002; Utichke *et al*., 2004; Dissanayake and Stefansson, 2012). Therefore, the sea cucumber management has now become a worldwide concern (Bruckner *et al*., 2003; Conand, 2004; Kinch *et al*., 2008; Purcell *et al*., 2011).

The increasing demand of sea cucumber worldwide causing most of the high-value sea cucumber stocks have been overexploited. As a consequences, the management seem to be shifted towards the low value species such *H. atra* (Lovatelli *et al*., 2004; Choo, 2008; Dissanayake and Stefansson, 2012). In international markets, *H. atra* named as black lollyfish, but in local (Indonesia), *H. atra* has many different names for each region (e.g. teripang hitam, keling, perut hitam, dara, cera). The knowledge of many sea cucumber species on ecological preferences remains largerly unexplained (Dissanayake & Stefansson, 2012), therefore, the management approach to conserved on the trading species seems lack of evidence. In that point of view, it is necessary to do a research to get baseline information on bio-ecological aspect to as many as possible species of sea cucumber particularly on the trading species. The purpose of this study was to investigate the frequency and early supposition seagrass association preference of *H. atra* in an intertidal seagrass bed off Bama beach, Baluran National Park.

II. METHODS

2.1. Study Site

The study was conducted in a single trip in May 2011, located at the Bama Beach, eastern side of the Baluran National Park (Figure 1). The geographical position and habitat characteristic of each transect are presented in Table 1.

2.2. Field sampling

Investigation on frequency of *H. atra* individual used belt transect (1m x 100m with three replicates) orthogonal to the coast (Figure 1). Position of the transect was choosen based on high frequency

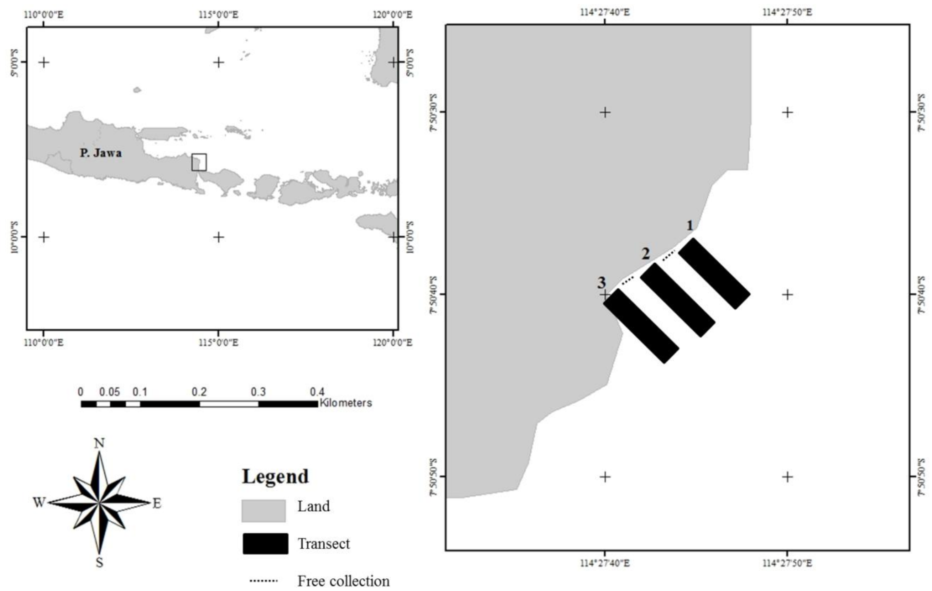

Figure 1. Study location (black solid rectangulars) at Bama beach, Baluran National Park.

Table 1. Description of the sampling area.

	Coordinates	Frequency of *H. atra*	Habitat characteristic
Transect 1	S 7˚50′ 37.30″ E 144˚27′ 43.26″	34	Sandy substrate dominated by *Cymodocea rotundata* (CR)
Transect 2	S 7 ˚50′ 38.7″ E 144˚27′ 40.9″	34	Sandy substrate dominated by CR and EA
Transect 3	S 7˚50′ 40.15″ E 144˚27′ 38.18″	55	Fine sandy-muddy substrate dominated by *Enhalus acoroides* (EA)
Free collection	Not recorded	23	Bare sandy substrate

zoning of *H. atra*. Distance between the center points of each sampling area was 10 m. Therefore, the total covered area in this survey was 300 m^2 (100 m^2 x 3). Within the transect, frequency of *H. atra* and their association with seagrass were recorded. Substrat type of the survey were also visually recorded.

Each individual found within the transect were manually measured its length using gauge (1 mm accuracy) and their wet weight using digital weighting scale (Ohaus 1000 g accuracy). When measuring the length, it was ensured that no hand contact with the individual of *H. atra*, since it will cause the contraction that could make its body shrinking. Furthermore, weight in this study relied on total wet body weight. Finally, all individuals that have been noted and measured were returned back to the field.

Free collection was conducted in front of the mangrove area which still can be found many *H. atra* that uncovered by the sampling area. This additional method was carried out to enrich the data. Afterwards, all the data of body weight and length were classified into three categories i.e., small size (weight ≤ 199 g; length ≤ 9.9 cm); medium size (weight 200-499 g; length 10-30.99 cm), and large size (weight ≥ 500 g; length ≥ 31 cm). Furthermore, the associations of H. atra were classified into four conditions i.e, association with seagrass *Enhalus acoroides* (EA); association with seagrass *Cymodocea rotundata* (CR); association with mix seagrass (EA+CR), and no association (NA).

III. RESULT AND DISCUSSION

3.1. Result

The physical condition of each transect site and free collection area were identical i.e., 30℃ of the temperature and 35 of the salinity. A total of 146 individuals of *H. atra* were recorded on this study (Table 1). Out of those, 37.67% were captured in association with seagrass EA, 23.29% with CR and mix (EA+CR), respectively. The rest 15.75% were individual who exposed in bare sandy substrate with no association (Figure 2).

Viewed from the body weight distribution, small size individual were captured in the entire of survey area, but mostly they were captured in association with EA (55 individuals). Medium size individuals were captured only in association with CR (9 individuals) and mix seagrass species (1 individual). Large sizes which only consist of 2 individuals were captured in association with CR (Figure 3).

Based on body length distribution, mostly individuals of *H. atra* were in medium size (137 individuals). Small size consisted of only three individuals and large size consisted of six individuals. Furthermore, individuals of small size were captured in association with EA (2 individuals) and mix (1 individual). Whereas, the most individual of medium sizes were captured in association with EA (53 individuals), then mix seagrass (33 individuals), CR (28 individuals), and no association (23 individuals). Meanwhile, large size individuals were only capture in association with CR (6 individu) (Figure 4).

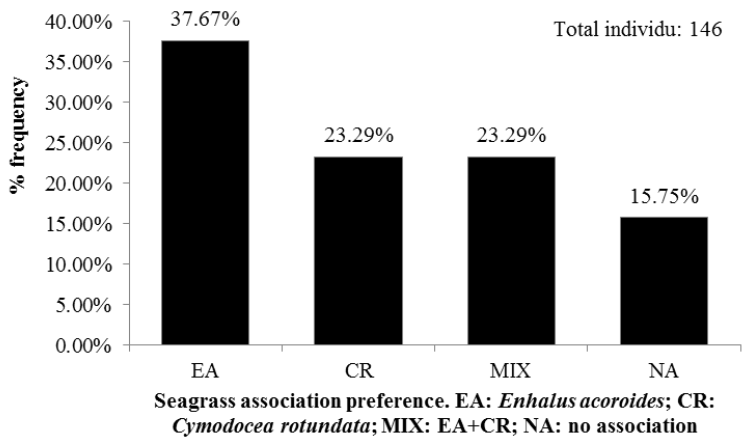

Figure 2. Percentage of *H. atra* individual which associate with seagrass stands.

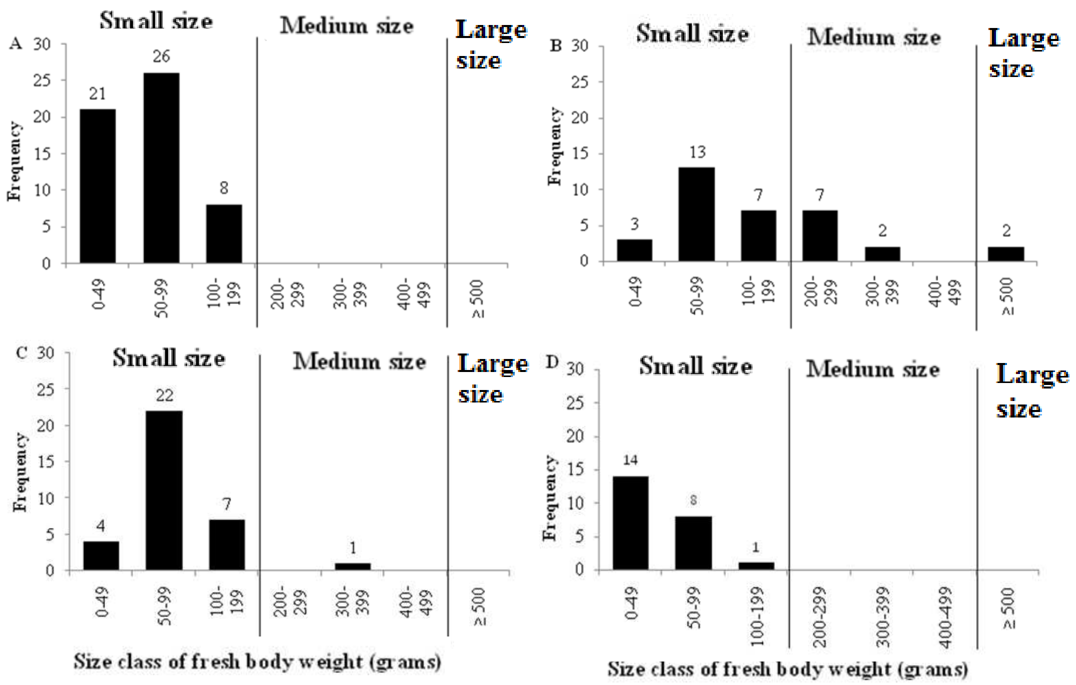

Figure 3. Weight distribution of *H. atra* with their seagrass association preference, A: *Enhalus acoroides* (EA); B: *Cymodocea rotundata* (CR); C: mix seagrass (EA+CR); D: no association. (Numbers above the bars represent total individuals in particular categories).

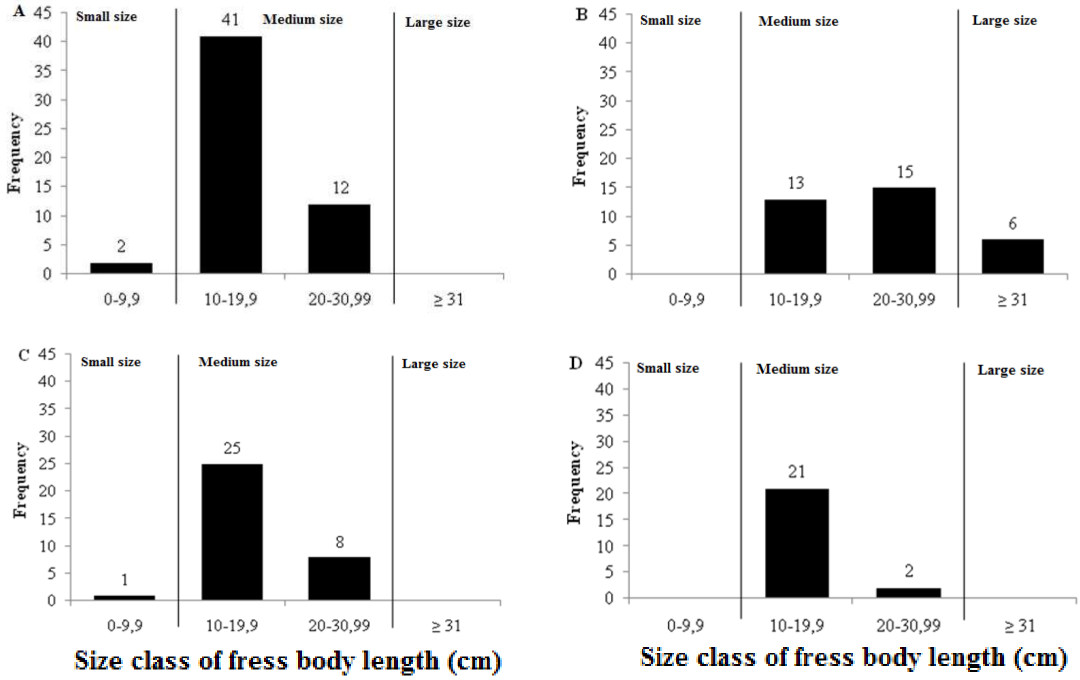

Figure 4. Length distribution of recently *H. atra* individual with their seagrass association preference, A: *Enhalus acoroides* (EA); B: *Cymodocea rotundata* (CR); C: mix seagrass (EA+CR); D: no association. (Numbers above the bars represent total individuals in particular categories).

3.2. DISCUSSION

Holothuria atra is the most common and most abundant sea cucumber species in some part of Indonesian waters (Yusron, 2001a; Yusron, 2001b; Yusron, 2007; Yusron and Widianwari, 2004). Dense aggregation of *H. atra* in the shallow water seagrass area in Bama beach, Baluran National Park was observed in this study. Those high frequency individuals may related not only because of the sampling location was a conservation area which protect all species inhabiting from human exploitation but also it could be related to the food availability.

Several study had been conducted to understanding the possibility of habitat preference of sea cucumber (Eriksson *et al.*, 2012; Dissanayake and Stefansson, 2012; Purcell *et al.*, 2009; Purcell, 2004; Shiell, 2004; Conand and Mangion, 2002; Conand, 1990). Most of those study concluded that the organic material was one of the most important factor influencing the habitat preference of sea cucumber. Since the highest density of *H. atra* was recorded in the seagrass habitat (Dissanayake and Stefansson, 2012), I hypothesized that sea cucumber (*H. atra* in particular) may prefer vegetation in seagrass habitat.

The result showed that most individuals of *H. atra* in this study area were captured in association with seagrass (see Figure 2). The observed affinity of *H. atra* with seagrass may be related to the sheltering effect of the seagrass canopy and nutritional factor in the bottom of seagrass. Based on Komatsu *et al.* (2004), the seagrass will trap more nutrient in the baseline which certainly bring benefit to the benthic community inhabiting in seagrass area including *H. atra*.

Most of the *H. atra* in this study was found in association with EA, of which dominated by small individual (weight categories). Otherwise, individual which associated with seagrass CR more varied in weight and length size. Mix seagrasses (EA+CR) were dominated by individual with small to medium. Furthermore, individual which had no association with seagrass was only found in small size (see Figure 3). Based on those result, it showed a tendency that smaller (in weight) individual of *H. atra* inhabiting Bama beach might prefer to live in any habitat with or without seagrass vegetation, even specifically they were mostly in association with taller seagrass stands (EA). However, this wa still provisional conclusion because the result of length distribution showed a different pattern. Individuals in small size were captured in only association with EA and mix vegetation, otherwise the medium size individuals were found in all survey areas with or without seagrass (see Figure 4). In general, all large size individuals were always in association with CR (see Figure 3 and 4).

Seagrass are significantly reducing water movement close to the sediment surface (Komatsu *et al.*, 2004). Considering this ecological role of seagrass, this study suggested that the taller seagrass stands will make better sheltering area for smaller individual. There was also a tendency that small to medium size individual were prefer to non-specifically associate with shorter (CR) or taller (EA) or mix seagrass. On the other side, large size individuals were always associate with shorter seagrass. Therefore, we can assume that *H. atra* could experience the ontogenetic habitat shift, since in many marine species the habitat shift may occurs on different stage of the life-history (Shiell, 2004; Bos *et al.*, 2011; Erickson *et al.*, 2012). However, more investigation is still needed especially for *H. atra*, although several publications had been reported that juvenile of *Archaster typicus* (Asteroidea; Echinodermata) preferred to live in the bottom of mangroves area then gradually move to seagrass, sandy habitats, and shoals as they get older (Bos *et al.*, 2011).

H. atra are deposit feeders and their dense aggregation in seagrass habitat could be related to their feeding. Since seagrass area rich of particulate matter and detritus (Komatsu *et al.*, 2004; Thangaradjou and Kannan, 2007) and *H. atra* ingest sand grains and digest organic matter attatched to them (Bakus, 1973; Dissanayake and Stefansson, 2012; Anonymous, 2011), therefore, this kind of bioturbation possibly raise the seagrass beds productivity (Schneider *in* Eriksson *et al.*, 2012). The study showed the highest frequency of *H. atra* were found on the vegetated bottoms of EA which visually fine sandy-muddy substrate type. I assumed that EA bottom had the higher organic matter content than the others. Anyhow, some marine species tend to experience in aggregation, and their distribution could be influenced by biotic relationships, sediment characteristics (i.e., grain size and organic content), and habitat variable such as shelter availability (Conand, 1989; Dissanayake and Stefansson, 2012; Shiell and Knott *in* Eriksson *et al.*, 2012).

Considering that sea cucumbers become depleted because of excessive hunting in their natural habitats some commercialy low value species such *H. atra* seems to be the next (or suplementary) commodity (Bruckner *et al.*, 2003; Tuwo, 2004; Lovatelli *et al.*, 2004; Purwati and Yusron, 2005; Choo, 2008; Purwati *et al.,* 2010; Purcell *et al.,* 2011; Dissanayake and Stefansson, 2012). The results from this study could be used as a baseline information for further development of viable restocking programs. However, more investigations are still needed to convince that smaller individual of *H. atra* prefers to associate with EA.

IV. CONCLUSION

Holothuria atra was observed in high frequency at Bama beach, Baluran National Park. Most individual were captured in association with seagrass. The results showed that all individuals associated with EA were individual with smaller weight. This condition can be related to the sheltering effect of the seagrass canopy and the present of abundant nutrient in the bottom of seagrass area.

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