SEDIMENT REMOVAL ACTIVITIES OF THE SEA CUCUMBERS *Pearsonothuria graeffei* AND *Actinopyga echinites* IN TAMBISAN, SIQUIJOR ISLAND, CENTRAL PHILIPPINES

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Teripang terkenal mengkonsumsi sejumlah besar sedimen dan dalam proses meminimalkan jumlah lumpur yang negatif dapat mempengaruhi organisme benthic, termasuk karang. Kegiatan pengukuran kuantitas pelepasan sedimen dua spesies holothurians (*Pearsonuthuria graeffei* dan *Actinophyga echites*) ini dilakukan di area yang didominasi oleh ganggang dan terumbu terumbu karang di Pulau Siquijor, Filipina. Hasil penelitian menunjukkan bahwa *P. graeffei* melepaskan sedimen sebanyak 12.5±2.07% sementara pelepasan sedimen untuk *A. echinites* sebanyak 10.4±3.79%. Hasil penelitian menunjukkan bahwa kedua spesies ini lebih memilih substrat yang didominasi oleh macroalgae, diikuti oleh substrat berpasir dan coralline alga.

Kata kunci: teripang, sedimen, Pulau Siquijor

INTRODUCTION

Coral reefs worldwide are declining at an alarming rate due to natural and human-induced factors (Pandolfi *et al*. 2003). Anthropogenic factors include overfishing, pollution, and agriculture resulting to high sedimentation (Hughes *et al*. 2003; Bellwood *et al*. 2004). Sedimentation is also a major problem for reef systems (Hallock, 2001). Sediments can smother coral colonies and other reef organisms (Rogers 1990), which in turn may affect marine biodiversity and fisheries (White *et al.* 2000).

Sea cucumbers or sand fishes are well-known as “vacuum cleaners” of the sea because they consume large quantities of sediment. These organisms promote bioturbation and recycling of organic material within the sediment (Wheeling *et al.* 2007). Two holothurians species *Pearsonuthuria graffei* and *Actinopyga echinites*, are found throughout the Indo-Pacific region (Clark and Rowe, 1971) and are in high abundance in certain areas of the central and southern Philippines. These motile species are found in algae-dominated coral reef.

P. graffei occurs mainly on corals and sponge where they appear to graze on epifaunal algal films, while *A. echinites* is a deposit feeding holothurian that occurs mainly in sandy environments. These two species also differ on their diel cycle since *A. echinites* is observed only at night while *P. graffei* is active during daytime.

The main aim of this study was to evaluate the differences in the amount of sediments removed by two species of sea cucumbers (*P. graeffei and A. echinites)* in a shallow reef dominated by macroalgae with patches of live hard corals. This study is of high significant addition to the growing knowledge of the ecology (with emphasis on sediment removal) of these species of sea cucumbers. In addition, most studies done on the macroinvertebrates in the study area focused on abundance (Wagey *et al*.

2017) and harvest (Wagey & Bucol, 2016).

MATERIALS AND METHODS

Description of The Study Area

The study was conducted in Bobaboc Reef (9.186558°N, 123.447785°E) located in Sitio Lapac, Brgy. Tambisan, San Juan, Siquijor (Fig. 1). The site is recognizable by a limestone outcropping (0.14 ha), also known as an emerged fossil reef. The entire reef area is 6.68 hectares but in this study only the reef flat (2.13 hectares) with depth from 1.5 to 5 meters was visited. The samples were obtained in an algal dominated portion of the reef. Two species of sea cucumbers, *P. graffei* and *A. echinites* were used in this study. Data were collected during day (0730-1700) and night (1930-2100) for *P. graeffei* and *A. echinites*, respectively.

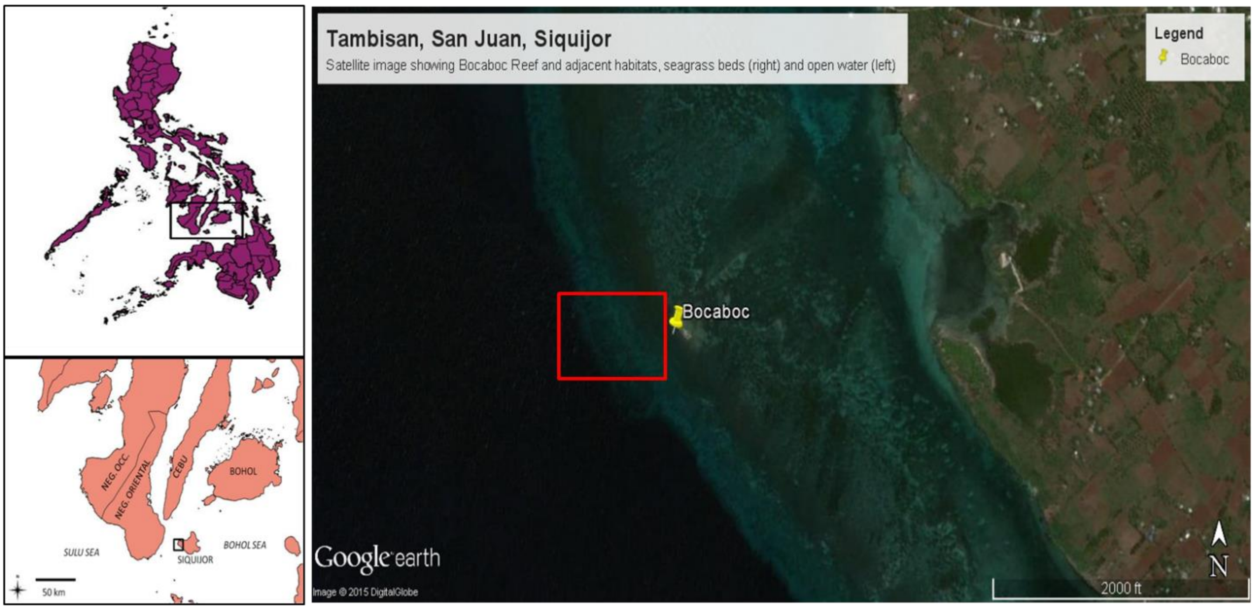

Figure 1. Locator map showing location of the study site.

The Following Hysico-Parameters were Taken In Situ during The Entire Sampling

Water temperature data during the sampling were determined using a field thermometer (atmospheric and subsurface). Salinity, on the other hand, was determined with the use of hand held refractometer. Depth was measured using a dive computer (Suunto®). Aside from an in situ measurement of sea surface temperature (SST), additional data on SST for the entire year was downloaded (freely accessible at http://coralreefwatch.noaa.gov/satellite/vs/philippines.php#BoholSea_Philippines) from the satellite virtual station for the entire Bohol Sea.

Sediment Removal by Sea Cucumbers

Specimens of *P. graffei* and *A. echinites* were selected within the research area. The animal was carefully moved not to disturbed the sediment. All sediments within an area of 25cm or 5cm x 5cm quadrat (each immediately before the mouth and after the anus) were removed using a suction generated by 60 ml syringes. Typically 3-4 syringes were suctioned and were placed in labeled plastic

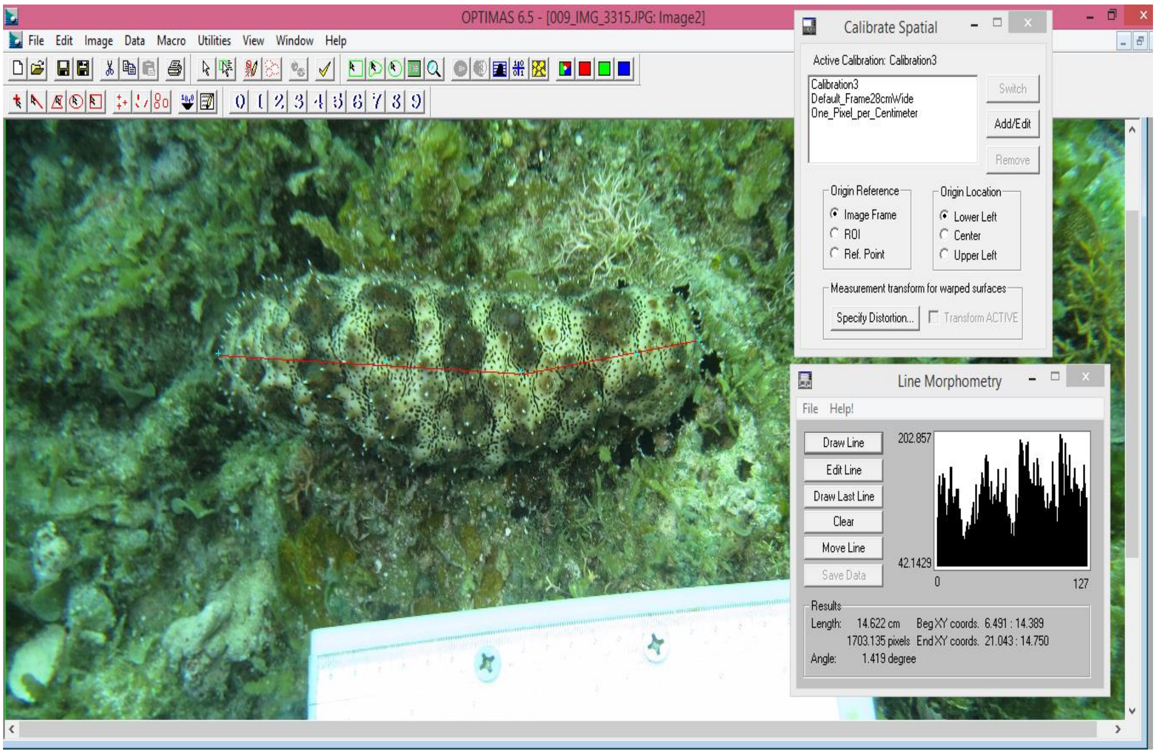

Figure 2. A sample photo of sea cucumber *P. graeffei* measured using the software Optimas.

bottles. All the samples obtained were transported to the Biology Laboratory of Negros Oriental State University (NORSU), Main Campus I in Dumaguete City. The sample sediments from each quadrat were filtered using a filter paper and the filtrate oven-dried for 24-48 h to constant weight. After which dried mass were determined for each sample using the following equation:

$$\%\ \text{Mass Removal} = \frac{\text{Sediment}^{(\text{anterior})} - \text{Sediment}^{(\text{posterior})}}{\text{Sediment}^{(\text{anterior})}} \text{ X } 100$$

Measurement of Length

To determine length (in cm) of the sea cucumbers without disturbing (most sea cucumbers retract when touched or disturbed) them while feeding, underwater photograph was taken for each individual. A plastic slate (used to record other field data with attached ruler) was placed about 5-7cm away from the sea cucumber to serve as calibration for further measurement using the image analysis software (Optimas).

RESULTS

Physico-Chemical Parameters

During the sampling in March 14-15, 2015, the following data on physic-chemical parameters were taken, consistent with at least three readings. Atmospheric temperatures

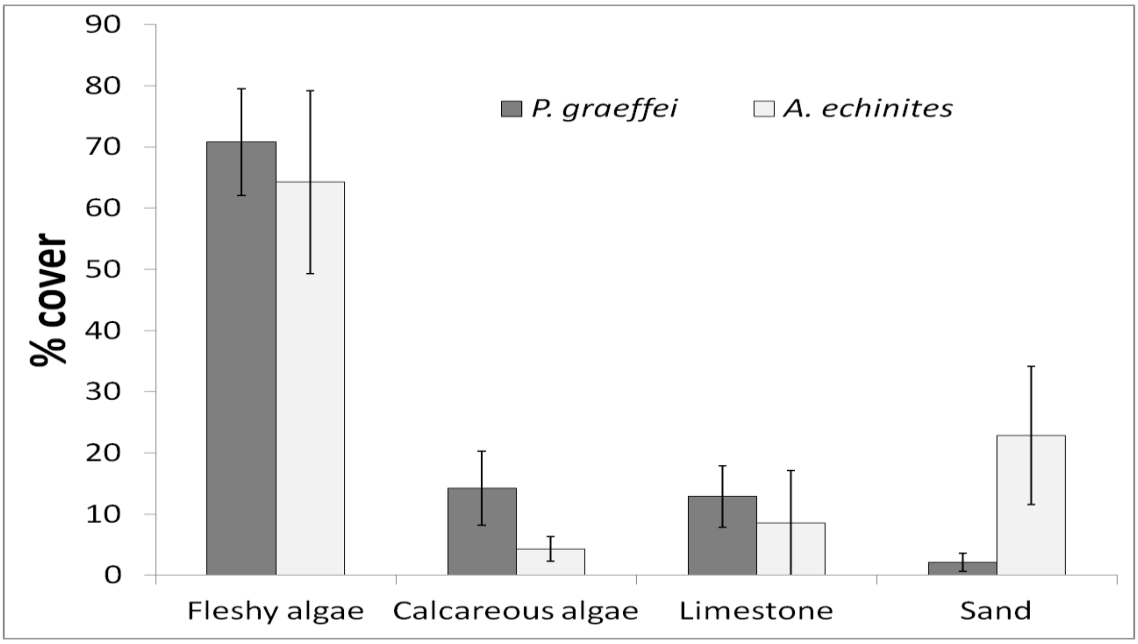

Figure 3. Substrate preference (in % cover) of the two sea cucumber species in the study site. Error bars indicate standard error (SE) from the mean.

ranged from 26-27°C while sub-surface temperature ranged from 26-27°C. These values were similar to the satellite readings by the NOAA (National Oceanographic and Atmospheric Administration) during the days of the sampling.

Following months from March to early May 2015 indicate warming sea surface temperatures. Salinity readings (33-35‰) were typical of marine waters without any influence from freshwater source. The nearest freshwater outflow is located about 5 kilometers away in Poblacion, San Juan and has very relatively low volume flow to influence the study site.

Substrate Preference

By examining the substrate type underneath each of the sea cucumbers subjected to this study, fleshy macroalgae (70.8±8.7% Standard Error or SE althroughout this report for *P. graeffei* and 64.3±15% for *A. echinites*) were the most dominant substrate (Figure 3). The rest of the substrates (live coral, rock, etc) were less preferred by both species, although sand (23±11.2%) appears second as preferred substrate for *A. echinites.* This might be due to the burrowing habit of this species on sand at daytime and emerged at night time among macroalgae to feed.

Sediment Removal

Figures 3 and 4 show the sediment removed (expressed in mean ± %) by the two sea cucumber species. *P. graeffei* removed as much as 12.5±2.07% while *A. echinites* removed 10.4±3.79% of sediment. These values were notably lower compared to those reported by Nestler et al. (2014) for *P. graeffei* in Agan-an Marine Reserve, Sibulan, Negros Oriental. Unlike most of the coral reefs in the western side of Siquijor, including our study site, it should be noted that Nestler's site is proximate to dense population and river discharges. For this reason, the sediments located before the mouth of the two sea cucumber species reached 20 mg/cm^2. According to Nestler (2014), as little as 12 mg/cm^2 amount of sediment can have damaging effects on the coral.

In this study, the sediments before the mouth only had mean mass of 9.8±1.75 mg/cm^2 and 7.9±0.7 mg/cm^2, for *P. graeffei* and *A. echinites*, respectively. In addition, as shown above, these sea cucumbers ingested about 10-12 % of the sediment, which might also explain the reduced sediment mass after the anus of most of our samples (Figure 5).

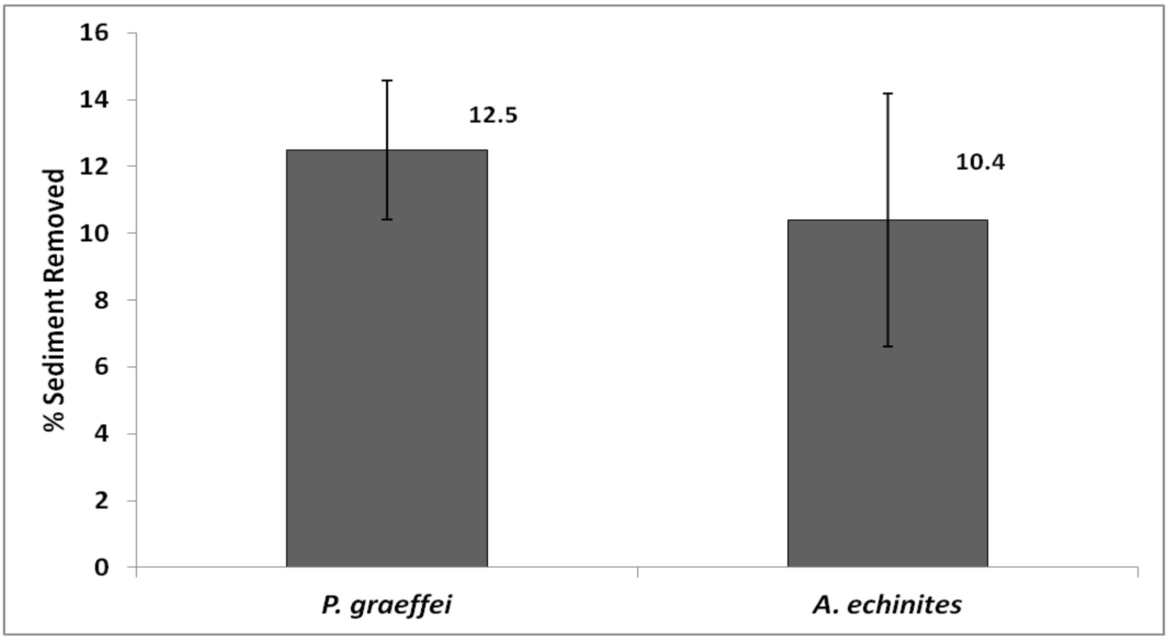

Figure 4. Mean % removed sediment of *P. graeffei* (N=22) and *A. echinites* (N=10).

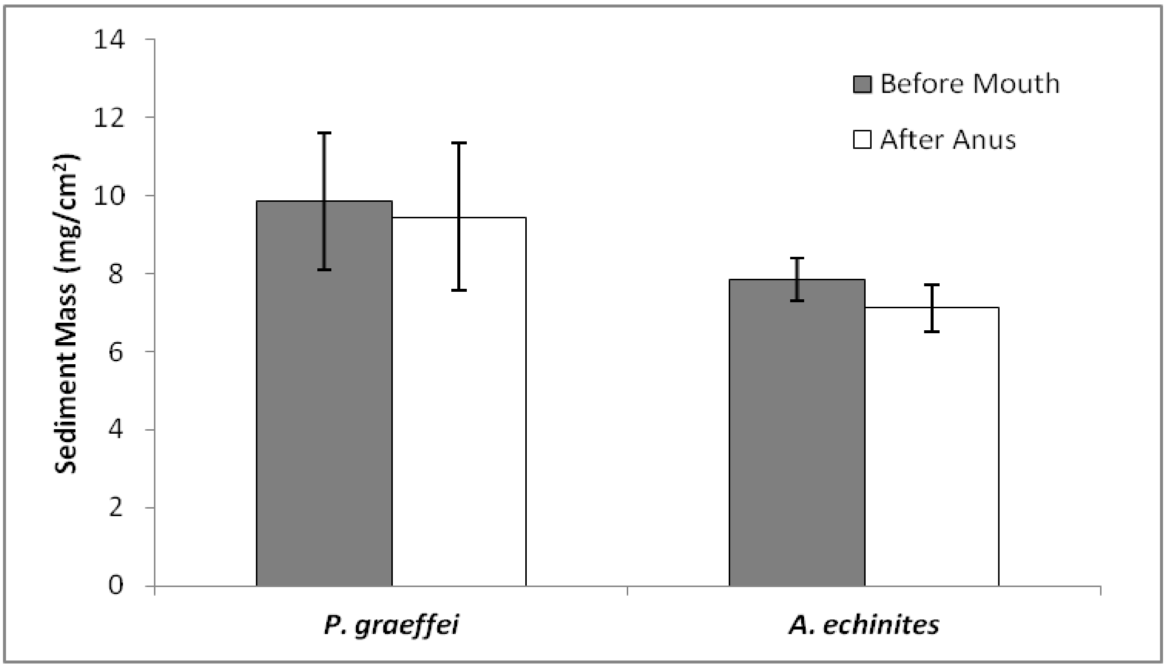

Figure 5. Mean sediment mass (mg/cm^2) before the mouth and after the anus of *P. graeffei* (N=22) and *A. echinites* (N=10).

DISCUSSION

The two species included in this study (*P. graeffei* and *A. echinites*) are relatively common in the algal beds throughout their range in the Indo-Pacific region (www.sealifebase.org, 2015). While *P. graeffei* have been regarded to feed on excess sediment in the coral-dominated reef (Nestler *et al*. 2014), thereby benefitting corals in the process, very little is known about its sediment-removal impact in algae-dominated reef. It should be noted that an algal-dominated state of coral reefs is expected to occur on a global scale (Hughes *et al*. 2003, 2007; Bellwood *et al*. 2011) as a direct result of excessive nutrient input and overfishing.

In this study, both species were able to remove sediments amounting to at least 10%. Although this figure is six times lower compared to an earlier study done by Nestler et al. (2014) in Agan-an Marine Reserve in Negros Oriental. This might be caused by some other factors including size differences of the sea cucumbers. It is possible that most of the individuals subjected to this study are mostly juveniles (13 cm for *P. graeffei* and 7 cm for *A. echinites*) all in depths lower than 3m while most of those in Agan-an Reserve were more than 30 cm in length and found at depths of 12-15 meters (Nestler, J. pers.com).

Given that there is no primary cause of sedimentation such as run-off from agriculture and in the absence of a river nearby, there is only a small amount (below 10 mg/cm^2) of sediment available for the sea cucumbers (before mouth the mouth). According to Fabricius (2005), corals can be negatively affected by sediments as low as 12 mg/cm^2. This study parallels to the findings of Nestler (2014) that sea cucumbers reduce the amount of sediment or at least maintains the level below the potential damage threshold.

CONCLUSION AND RECOMMENDATIONS

This study provides some information on the sediment removal ability of two sea cucumber species (one active during day time, *P. graeffei* and one active at night time, *A. echinites*) in an algae-dominated reef in Tambisan, San Juan, Siquijor. Although *P. graeffei* has been regarded as reef species, this study documented that this species prefers fleshy macroalgae as substrate. It is highly possible that the individuals encountered were mostly juveniles. Larger individuals (adults) found in deeper (>5m) parts of the coral reef were not included in this study. It is highly possible that larger individuals may also have higher sediment removal compared to smaller individuals.

We recommend that the number of samples be increased and should include a wider range of size classes. In addition, the temporal (seasonal) and spatial variation should also be considered for future studies. Furthermore, some of the physic-chemical parameters (atmospheric and sub-surface temperatures, salinity, etc) should be monitored year-round.

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