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RESEARCH ARTICLE

Population Density, Distribution, and Species Composition of Sea Cucumbers in Pagasinan Tidal Flat, Bongao, Tawi-Tawi, Philippines

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ABSTRACT

This study investigated the population density, distribution, and species composition of sea cucumbers in Pagasinan Tidal Flat, Bongao, Tawi-Tawi, Philippines. Sea cucumbers were collected in the night along the tidal flat and by snorkeling along the reef area. The study recorded seven species belonging to genera *Holothuria* (five species), *Bohadschia* (one species), and *Stichopus* (one species). The population densities ranged from 0.09 ± 0.5 to 3.85 ± 1.67 individuals per 100 m^2 each with varying habitat preferences.

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1. INTRODUCTION

Harvesting of sea cucumbers in the Philippines has been practiced since the late 18th century (Choo 2008). However, gathering these aquatic species in the country is unregulated because of inadequate implementation of pertinent laws resulting in overexploitation (Jontila et al. 2017). Sea cucumbers are mainly harvested and processed into "bêche-de-mer" or "trepang,"—dried sandfish that command a high price as these are primarily exported to Asian markets such as Hongkong, Korea, Singapore, Taiwan, and Japan (Conand 2004; Ferdouse 2004; Choo 2008). In some Indo-Pacific countries such as the Philippines, Indonesia, Fiji, Papua New Guinea, Tonga, the Maldives, and others, sea cucumber fishery used to be an essential source of income for fishers, as evidenced by overfishing and fishing in other coastal and coral reef resources (Quevedo et al. 2013; Purcell et al. 2016). There are 100 known species on record, and about 25 species are commercially exploited (Gamboa et al. 2004; Choo 2008). The highest valued sea cucumbers derived from *Holothuria scabra* (sandfish), *Holothuria nobilis* (black teatfish), and *Holothuria fuscogilva* (white teatfish) are some of the species preferred by sea cucumber consumers globally (Chong et al. 2015).

Despite overfishing, the Philippines remains the second top sea cucumber-producing country in Southeast Asia, next to Indonesia. The sea cucumbers are mainly harvested from capture fisheries and aquaculture. Tawi-Tawi, the southernmost province, is one of the Philippines' significant sandfish collection hotspots (Alejandro 2019). Due to the sea cucumbers' nocturnal behavior, gatherers in Tawi-Tawi collect them mostly at night using lights (N. Pahut, pers. comm) by gleaning during low tide or diving during high tide. This practice of collection is also done in Palawan province (Schoppe 2000). However, only a few studies on sea cucumber population, density, and abundance in the Philippines have been conducted (Quevedo et al. 2013; Jontila et al. 2014; Dolorosa 2015; Jontil et al. 2017; Dolorosa et al. 2017; Jaafar et al. 2018; Jontila et al. 2018). In Bongao, Tawi-Tawi in particular, no documentation of sea cucumbers has been made to date. Information on the population density, distribution, and species composition of sea cucumbers is essential for proper management and utilization. Hence, a preliminary study was undertaken to investigate the population size and density, distribution, and species composition of sea cucumbers in Pagasinan tidal flat, Bongao, Tawi-Tawi, Philippines.

2. MATERIALS AND METHODS

2.1 Study Site

The study area where we collected the samples is part of the Bongao channel (Figure 1). It is a tidal flat with a sandy and sandy-muddy bottom. It has a patch of mangroves and a moderately dense, stilt house community. It is relatively protected from the waves caused by monsoon winds throughout the year.

2.2 Population Size and Density, Distribution, and Species Identification

Majority of sea cucumbers are nocturnal species. Thus, night sampling was done by gathering all the sea cucumber samples for an average of three hours per sampling session for 18 nights. Three transect lines (20 m x 5 m) were laid during each sampling period, with a total of 53 transect lines for 18 samplings. Using rechargeable lamps as a light source, only sea cucumbers within the 100 m^2 were collected in the tidal flat during low tide and the samples were placed in basins. Collected samples were segregated and weighed to the nearest 0.5 g and measured to the nearest 0.5 cm. The habitats of the samples were also noted. Different species were identified according to their external anatomical characteristics in reference to the book of Purcell et al. (2012) entitled "Commercially Important Sea Cucumbers of the World." The population density was calculated by dividing the number of individuals by the number of covered areas.

2.3 Data Analysis

Data collected were analyzed using descriptive statistics in IBM SPSS Statistics version 20.

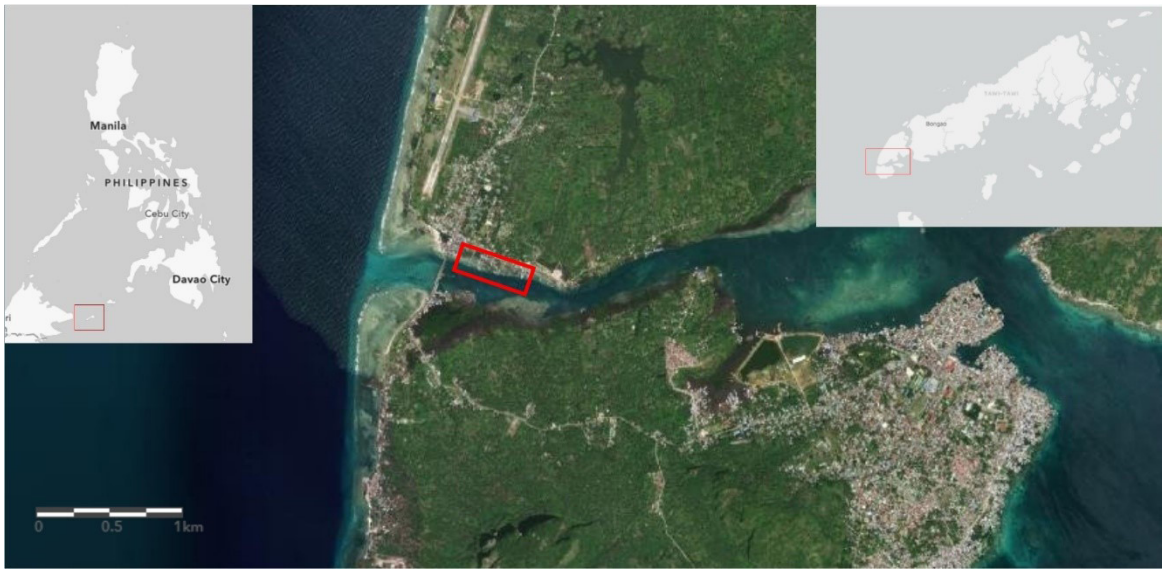

Fig. 1. Map of study area showing the sampling site (Source: ArcGIS)

3. RESULTS

3.1 Species Composition and Distribution

Seven species of sea cucumbers were noted as belonging to families Holothuriidae (six species) and Stichopodidae (one species). There were five species under genus *Holothuria* (*Holothuria scabra, H. fuscocinerea, H. hilla, H. atra,* and *H. coluber*), one species under genus *Bohadschia* (*Bohadschia marmorata*), and one species under genus *Stichopus* (*Stichopus herrmanni*) (Figure 2). The total recorded individuals were 379 (208 *H. scabra*, 80 *H. fuscocinerea*, 58 *B. marmorata*, 21 *H. hilla*, 5 *Stichopus herrmanni*, 4 *H. coluber*, and 3 *H. atra*).

The distribution of sea cucumbers varied from sandy to coral rubble substrates and from seagrass beds to coralline reef areas. The majority of the *H. scabra* were associated with seagrass in the sandy-muddy substrate near the mangroves. *H. fuscocinerea* were abundant in the sandy-muddy substrate near the mangrove area, and most *H. hilla*

Fig 2. Sea cucumbers species at Pagasinan tidal flat, Bongao, Tawi-Tawi, Philippines
Family Holothuriidae:
A) *Holothuria scabra,* B) *Holothuria coluber,* C) *Holothuria hilla,*
D) *Holothuria atra,* E) *Holothuria fuscocinerea,* F) *Bohadschia marmorata*
Family Stichopodidae:
G) *Stichopus herrmanni*

shared the habitat with *H. fuscocinerea*, while a few have been found in the coral rubble area. *B. marmorata* thrived in a seagrass sandy area. *H. atra*, *H. coluber*, and *S. herrmanni* were found in a reef where there is coral rubble as well as in seagrass beds. Apart from sea cucumbers, associated species like small octopuses, starfishes, sea urchins, shrimps, gastropods, and bivalves were also found.

3.2 Population Size and Density

The average density of sea cucumbers observed in this study was about seven individuals per 100 m^2. The sampling area's most abundant sea cucumbers species was *H. scabra*, with 3.85±1.67 individuals per 100 m^2. It was followed by *H. fuscocinerea* with 1.48±0.62 individuals per 100 m^2. *B. marmorata* had a density of 1.07±0.23 individuals per 100 m^2. Finally, *H. hilla* had a density of 0.39±0.10 individuals per 100 m^2. The species with the least densities noted in this study were *S. herrmanni, H. coluber,* and *H. atra*, with 0.09±0.5, 0.07±0.4, and 0.06±0.41 individuals per 100 m^2, respectively (Table 1).

The size structure of the sea cucumbers varied from species to species (Table 1). The largest *H. scabra* encountered was 18.5 cm, while the smallest was 4.5 cm with an average size of 8.89±0.22 cm. The maximum size of *H. fuscocinerea* was 23 cm, and the minimum size was 6.5 cm, with an average size of 15.04±0.4 cm. The size range of *H. hilla* was 6.5 - 17 cm with an average size of 10.98±0.65 cm. The recorded size of *H. coluber* ranged from 10.5 - 17.5 cm with an average size of 12.25±1.75 cm. For *H. atra*, the

largest individual was 42 cm, and the smallest was 16.5 cm, with an average size of 25±8.5 cm. *B. marmorata* size ranged from 4 cm - 15 cm with an average size of 10.43±0.55 cm. Moreover, the size range of *S. herrmanni* was 5.5 – 18 cm, with an average size of 11.8±2.63 cm.

Table 1. Population Density and Size of Sea Cucumbers in Pagasinan Tidal Flat, Bongao, Tawi-Tawi, Philippines

Species	Mean (SE) population density (ind./100 m^2)	n	Mean (SE) length (cm)	Minimum length (cm)	Maximum length (cm)
Holothuria scabra	3.85±1.67	208	8.89±0.22	4.5	18.5
H. fuscocinerea	1.48±0.62	80	15.04±0.40	6.5	23.0
H. hilla	0.39±0.10	21	10.98±0.65	6.5	17.0
H. coluber	0.07±0.4	4	12.25±1.75	10.5	17.5
H. atra	0.06±0.41	3	25.00±8.50	16.5	42.0
Bohadschia marmorata	1.07±0.23	58	10.43±0.55	4.0	15.0
Stichopus herrmanni	0.09±0.5	5	11.80±2.63	5.5	18.0

4. DISCUSSION

Sea cucumbers in the Philippines are diverse, and in Palawan alone, there are 44 species of sea cucumbers (Jontila et al. 2014). Other studies on sea cucumber assessment in the country reported 18 species in Tubbataha Reefs Natural Park (Dolorosa 2015) and 16 species in Semut, Basilan province (Jaafar et al. 2018). However, only seven species were collected and identified in this study as the sampling site coverage was small.

It was observed that *H. scabra* was the most dominant species found in seagrass beds with sandy-muddy substrates near the mangroves. Similar findings were also noted in Arreceffi Island, Honda Bay, Palawan, where *H. scabra* was the most abundant sandfish species found in sandy seagrass beds (Jontila et al. 2017). *H. scabra* is typically found in inner flat reefs of fringing and lagoonal reefs, coastal sandflats, and seagrass beds with sandy-muddy substrates near mangroves. Furthermore, this species prefers to inhabit calm coastal areas, can tolerate low salinities, and is sometimes found in estuaries (Junus et al. 2018; Purcell et al. 2012). Most *H. scabra* individuals surveyed in this study were relatively young (juveniles) (mean: 8.89±0.22 cm) with only about 19 cm as the maximum size. Higher densities of *H. scabra* in this study were mostly observed during the six nights of the new moon. Pitogo et al. (2016) reported that lunar phases have an influence on the size and density of *H. scabra*. They noted a higher density of *H. scabra* during the new moon than full moon phases.

The second dominant species was *H. fuscocinerea*. This species has also been documented in Palawan (Jontila et al. 2017). According to Purcell et al. (2012), *H. fuscocinerea* inhabits the reef lagoonal or reef flats and outer reef slopes and has no commercial value. In this study, this species was found in a tidal flat with a seagrass bed with a sandy-muddy substrate near the mangrove area. Despite their low value, this species is one of the most commonly collected species by the gleaners because it is consumed raw by the locals.

The third abundant species was *B. marmorata*, which is usually found in sandy seagrass beds. This species has also been reported in other provinces in the country, such as in Palawan (Jontila et al. 2017) and Basilan (Jaafar et al. 2018) in seagrass beds with sandy and sandy-muddy substrates. Purcell et al. (2012) noted that this species buries itself in sediment during the day and forage on sediment surface during the nighttime. In Tawi-Tawi, this species has less commercial value than *H. scabra*, but the meat is used for local consumption. Locally, gonads which are

extracted and referred to as "sanduley" by the Badjaos, are eaten as part of their traditional diets.

H. hilla was found in the tide pool, with coral rubble, and within the seagrass beds. This species can also be found in the sandy-rocky substrate in Basilan (Jaafar et al. 2018). Purcell et al. (2012) stressed that this species is generally found in the coarse sandy bottoms of up to 20 m. In Tawi-Tawi, this species is a special delicacy as "bêche-de-mer" consumed by Muslim locals, mainly during Ramadan, but it also has low economic value.

The least dominant sea cucumbers noted were *S. herrmanni, H. coluber,* and *H. atra,* distributed in seagrass beds and reef areas. Jaafar et al. (2018) reported that *H. hilla* in Basilan had a wide range of substrate preferences such as sandy, sandy with coral rubbles, and sandy-muddy seagrass beds. They also noted that *S. herrmanni* could be found in sandy-muddy substrate seagrass beds. *H. coluber* has been observed in seagrass beds and coralline flats with seagrass in Palawan (Jontila et al. 2017).

Results from this study indicated that the sampling site is a recruitment area, especially for *H. scabra*. Pagasinan tidal flat is a suitable habitat for sea cucumbers and is part of the Bongao channel with strong to moderate currents in and out of Tawi-Tawi Bay. Hence, it serves as settling substrates for planktonic larvae of sea cucumber. Although the area is occupied by local inhabitants (stilt houses), sea cucumbers and other marine aquatic resources are still found in the tidal flat. The lack of large-sized individuals and species may indicate that the locals overharvest sea cucumber resources in the area. Our findings are similar to what the fishers have reported. According to the fishers (mostly Badjaos), larger sizes (up to 20 cm for *H. scabra*) are hard to find nowadays compared to before. They used to gather larger sea cucumbers (especially *H. scabra*) and sold these as dried in the local markets as a source of livelihood, but now these are only collected for consumption purposes during bad weather when fishing is not possible. In Palawan and Pangasinan provinces, sea cucumbers are overexploited (Jontila et al. 2017; Olavides et al. 2010). Anderson et al. (2010) reviewed the level of exploitation of sea cucumber fisheries worldwide and revealed a considerable population reduction from sea cucumber fisheries due to overharvesting.

5. CONCLUSION

The high total population density of sea cucumbers surveyed in this study indicates that the Pagasinan tidal flat in Bongao, Tawi-Tawi, Philippines is a crucial habitat for the economically valuable sea cucumbers. Large numbers of juvenile individuals collected, especially sandfish *H. scabra*, imply that the area could be a recruitment and spawning ground. This study may serve as a preliminary source of information on the sea cucumber population's status in the area. It likewise highlights the significance of sea cucumber habitat protection and management.

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AUTHOR CONTRIBUTIONS

Ajik JO: Conceptualization, Data gathering, Writing—original draft preparation, Writing—review and editing. **Ajik MNH:** Data gathering, Writing—original draft preparation. **Tahiluddin AB:** Writing—original draft preparation; Writing—reviewing and editing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

No animal or human studies were carried out by the authors.

REFERENCES

Alejandro MB. 2019. Re-establishing the sea cucumber resources in the Philippines: The Masinloc experience. Fish for the People. 17(2):35-41. http://hdl.handle.net/20.500.12066/5517

Anderson SC, Flemming JM, Watson R, Lotze HK.

2010. Serial exploitation of global sea cucumber fisheries. Fish and Fisheries. 23. https://doi.org/10.1111/j.1467-2979.2010.00397.x

Chong WN, Pindi W, Chye YF Shaarani, MS, Lee SJ. 2015. Effects of drying methods on the quality of dried sea cucumbers from Sabah – A Review. International Journal of Novel Research in Life Sciences. 2(4): 49-64. http://eprints.ums.edu.my/id/eprint/12584

Choo PS. 2008. The Philippines: a hotspot of sea cucumber fisheries in Asia. In: Toral-Granda V, Lovatelli A, Vasconcellos M, editors. Sea cucumbers. A Global Review of Fisheries and Trade. FAO Fisheries and Aquaculture Technical Paper. No. 516. Rome, FAO. 119–140.

Conand C. 2004. Present status of world sea cucumber resources and utilisation: an international overview. In: Lovatelli A, Conand C, Purcell SW, Uthicke S, Hamel J-F, Mercier A, editors. Advances in Sea Cucumber Aquaculture and Management. FAO Fisheries Technical Paper No. 463. Rome: FAO. 13-23.

Dolorosa RG. 2015. The sea cucumbers (Echinodermata: Holothuroidea) of Tubbataha reefs natural park, Philippines. SPC Beche-de-mer Information Bulletin. 35:10-18.

Dolorosa RG, Salazar CB, Delfin MTV, Paduga JR, Balisco RAT. 2017. Sea cucumber fisheries in Rasa island wildlife Sanctuary, Narra, Palawan, Philippines. SPC Beche-de-mer Information Bulletin. 37:9–20.

Ferdouse F. 2004. World markets and trade flows of sea cucumber/beche-demer. In: Lovatelli A, Conand C, Purcell SW, Uthicke S, Hamel J-F, Mercier A, editors. Advances in Sea Cucumber Aquaculture and Management. FAO Fisheries Technical Paper No. 463. Rome: FAO. 101–117.

Gamboa R, Gomez A, Nievales MF. 2004. The status of sea cucumber fishery and mariculture in the Philippines. In: Lovatelli A, Conand C, Purcell SW, Uthicke S, Hamel J-F, Mercier A, editors. Advances in Sea Cucumber Aquaculture and Management. FAO Fisheries Technical Paper No. 463. Rome: FAO. 66-78.

Jaafar BH, Salapuddin AG, Quilala EPP. 2018. Abundance and Distribution of Sea Cucumbers in Barangay Semut, Basilan Province, Philippines. Ciencia. 37:49-60. Available from www.wmsu.edu.ph/research_journal

Jontila JBS, Monteclaro HM, Quinitio GF, Santander-de Leon SM, Altamirano JP. 2018. Status of sea cucumber fishery and populations across sites with different levels of management in Palawan, Philippines. Ocean Coast Manag. 165:225–234. https://doi.org/10.1016/j.ocecoaman.2018.08.025

Jontila JBS, Balisco RAT, Batin G. 2017. Species composition, density and distribution of sea cucumbers (Holothuroidea) at Arrecife Island, Honda Bay, Palawan, Philippines. SPC Beche-de-mer Information Bulletin. 37:21–29.

Jontila JBS, Balisco RAT, Matillano JA. 2014. The sea cucumbers (Holothuroidea) of Palawan, Philippines. AACL Bioflux. 7 (3):194–206. https://www.researchgate.net/publication/264237829_The_Sea_cucumbers_Holothuroidea_of_Palawan_Philippines_12

Junus S, Kwong PJ, Khoo G. 2018. A review on the recent advances in the biology and aquaculture technology of *Holothuria scabra*. J Surv Fish Sci. 4(2):5-25. http://sifisheriessciences.com/article-1-106-en.html

Olavides RDD, Edullantes CMA, Junio-Menez MA. 2010. Assessment of the sea cucumber resource and fishery in Bolinao-Anda reef system. Science Diliman. 22(2):1–12.

Pitogo KM, Sumin JP, Ortiz AT. 2016. Effect of lunar phases in the size distribution of *Holothuria scabra* on intertidal areas in Sarangani Bay, Philippines. SPC Beche-de-mer Information Bulletin. 36:48-53.

Purcell SW, Ngaluafe P, Foale SJ, Cocks N, Cullis BR, Lalavanua W. 2016. Multiple Factors Affect Socioeconomics and Wellbeing of Artisanal Sea Cucumber Fishers. PloS ONE. 11(12):e0165633. https://doi.org/10.1371/journal.pone.0165633

Purcell SW, Samyn Y, Conand C. 2012. Commercially Important Sea Cucumbers of the World. Food and Agriculture Organization. Rome, Italy. p. 150.

Quevedo B, Ronquillo P, Ruaza Jr. F. 2013. Distribution of intertidal holothurian fauna in Lianga Bay, Surigao del Sur. SDSSU Multidisciplinary Research Journal. 1(2):1-10. https://www.smrj.sdssu.edu.ph/index.php/SMRJ/article/view/68/66

Schoppe S. 2000. Sea cucumber fishery in the Philippines. SPC Beche-de-mer Information Bulletin. 34:25–28.