

SEA CUCUMBER (ECHINODERMATA: HOLOTHUROIDEA) SPECIES CHECKLIST IN PULAU TINGGI, JOHOR, MALAYSIA

NOR SHAHIDA AB RAHMAN¹, MUHAMMAD ASYRAF AZAHAR¹, NUR AMIRA SHAFIQA ROSLI¹, NUR SABRINA BADRUL HISHAM^{1,2}, SITI NAJIHAH SOLEHIN^{1,2}, 'AISYAH MOHAMED REHAN³, MD-ZAIRI ZAINAL⁴, MUHAMMAD ABU BAKAR ABDUL-LATIFF^{1,5,6} AND KAMARUL RAHIM KAMARUDIN^{1,2*}

¹Department of Technology and Natural Resources, Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (Pagoh Campus), 84600 Muar, Johor, Malaysia. ²Centre of Research for Sustainable Uses of Natural Resources, Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (Pagoh Campus), 84600 Muar, Johor, Malaysia. ³Department of Chemical Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia (Pagoh Campus), Pagoh Higher Education Hub, KM 1, Jalan Panchor, 84600 Muar, Johor, Malaysia. ⁴Shaz Resort Pulau Tinggi Sdn. Bhd., Lot 44, Kampung Penaga, Pulau Tinggi, 86800 Mersing, Johor, Malaysia. ⁵Environmental Management and Conservation Research Unit (eNCORe), Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (Pagoh Campus), 84600 Muar, Johor, Malaysia. ⁶Institute of Tropical Biodiversity and Sustainable Development, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia.

*Corresponding author: kamarulr@uthm.edu.my

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Abstract: There is still a lack of data on the species presence of sea cucumbers in Pulau Tinggi, Johor. Therefore, this study aimed to document the species checklist of sea cucumbers (Phylum Echinodermata: Class Holothuroidea) in Pulau Tinggi, Johor, Malaysia. The live sea cucumbers were collected for approximately two months from August 2019 to September 2019 during low tide. A total of ten species of sea cucumbers representing one order and two genera were documented. Among the total number of sea cucumbers collected from Pulau Tinggi, five species were under the Holothuria while another five belonged to the genus *Stichopus*. In Pulau Tinggi, *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835) was found to be the most prevalent species as it was documented and observed at all sampling sites. Furthermore, semi-structured interviews involving 15 respondents were incorporated during the data collection to obtain more information about the sea cucumber species. This study has contributed to the latest update on the list of sea cucumber species in Pulau Tinggi, as well as more updates related to the benefits of the sea cucumber to the residents, the environmental issues, the management and the conservation of sea cucumber in Pulau Tinggi.

Keywords: Sea cucumber, Pulau Tinggi, ossicle shape, species checklist, benefits to residents.

Introduction

Due to their diversity and economic worth, sea cucumbers (Echinodermata: Holothuroidea) are a significant component of Malaysia's marine heritage (Norazila *et al.*, 1999; Ceesay *et al.*, 2012; Kamarudin & Mohamed Rehan, 2015). Malaysia's local names include *timun laut*, *bat*, *balat*, *brunok* and *gamat* (Hashim, 2010; Kamarudin *et al.*, 2015). *Hoi sum* is another name for sea cucumber among Malaysia's Chinese population. Malaysia, one of the top 12 countries in the world for megadiversity is home to a variety of marine organisms, including sea

cucumbers (Baine & Forbes, 1998; Choo, 2008; Kamarudin *et al.*, 2010). Holothuroidea has been divided into six orders: Apodida, Aspidochirotida, Elaspodida, Dendrochirotida, Molpadiida and Dactylochirotida (Baine & Forbes, 1998; Kamarudin *et al.*, 2010; Kamarudin *et al.*, 2015). The morphologies of the calcareous skin ossicle or spicule such as C-shaped rod, table, rosette, perforated plate, I-shaped rod, button, anchor, boomerang and spider-shaped are typically used to classify sea cucumbers up to species level (Massin *et al.*, 2002; Samyn *et al.*, 2006; Zulfigar *et al.*, 2007; Hashim, 2011; Kamarudin & Mohamed Rehan, 2015).

The Indo-Pacific area now has the most varied species under the order Aspidochirotida. The greatest diversity in Malaysia is found in the order Aspidochirotida (Zulfigar *et al.*, 2007; Kamarudin *et al.*, 2009; Hashim, 2011; Kamarudin & Mohamed Rehan, 2015; Kamarudin *et al.*, 2015). In Malaysian coastal locations, five genera: *Stichopus*, *Holothuria*, *Bohadschia*, *Actinopyga* and *Thelenota* which comprise the large order Aspidochirotida were reported (Choo, 2008; Kamarudin *et al.*, 2015). Since 1985, research on sea cucumbers (Echinodermata: Holothuroidea) has been done in Peninsular Malaysia and Sabah (Kamarudin *et al.*, 2010; Kamarudin *et al.*, 2015). Most research used morphological traits as their primary technique of species identification (Zulfigar *et al.*, 2007; Kamarudin *et al.*, 2010; Hashim, 2011; Kamarudin *et al.*, 2015; Kamarudin & Mohamed Rehan, 2015; Kamarudin *et al.*, 2017). However, Pulau Tinggi, Johor did not have any reports on the species of sea cucumbers present.

Gamat is a marine animal used to make traditional medicines and the islands of Langkawi and Pangkor are famous for this. The

most well-known and extensively researched species is *Stichopus horrens*, which is used to make lipid extracts (*minyak gamat*) and bodily fluid extracts (*air gamat*) as well as nutritional supplements or health food items based on *gamat* (Kamarudin *et al.*, 2010; Hashim, 2011; Kamarudin *et al.*, 2015; Kamarudin & Mohamed Rehan, 2015). There was, however, a dearth of information regarding the uses and advantages of sea cucumbers for the residents of Kampung Tanjung Balang. The goal of this study was to compile a list of the sea cucumber species found in Pulau Tinggi, Johor, Malaysia as well as information about the sea cucumber's advantages for the local population, environmental concerns and management and conservation efforts on the island.

Materials and Methods

Study Sites and Collection Method

The Tinggi Island (hereafter referred to as Pulau Tinggi) in Mersing, Johor, Malaysia was selected (Figure 1). This research was conducted under the research permit Prk.ML.630-7 Jld.2 (15)

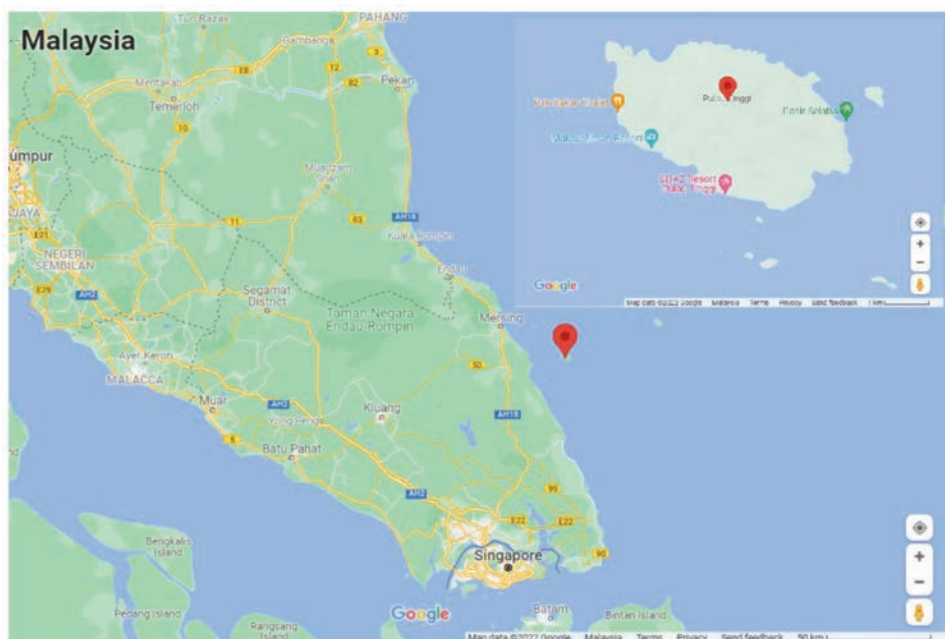


Figure 1: Map of Pulau Tinggi in Mersing District, Johor, Malaysia

Source: Google Maps

since the sampling site is a marine park. The live sea cucumbers were collected for approximately two months from August 2019 to September 2019 at low tide. The collected specimens were then photographed and measured using a measuring ruler. One specimen of each species was collected by handpicking and preserved in -20°C freezer before being provided by the Shaz Resort Pulau Tinggi Sdn. Bhd. before returning to the Universiti Tun Hussein Onn Malaysia Pagoh Branch Campus. "Catch and release" practice was applied during sampling for the other individuals of the same morphospecies. The sea cucumber specimens were identified morphologically onsite by referring to Hashim (2011), Purcell *et al.* (2012), experts, the World Register of Marine Species database (link - <http://www.marinespecies.org/index.php>) and through information provided by locals.

Ossicle Extraction and Shape Observation

In the laboratories of Universiti Tun Hussein Onn Pagoh Branch Campus, the species identification of sea cucumbers was done based on the skeletal elements, i.e., the ossicles that can be found in various parts of sea cucumber body. The procedures for ossicle extraction and shape observation by Kamarudin *et al.* (2017) were applied. Each sea cucumber specimen was dissected when it died. A small piece of tissue was cut with a sterilized scalpel and the small tissue was placed on a microscope slide. A few drops of sodium hypochlorite solution (i.e., concentrated household bleach) were placed on the tissue to dissolve the soft tissue from the ossicles. The soft tissue was dissolved within 20 to 30 minutes, leaving a white pellet of ossicles on the microscope slide. The ossicle shapes were examined under the Nikon ECLIPSE 80i digital compound microscope. The images of observable ossicles were captured digitally and recorded in the notebook to identify species based on the shape of the ossicles.

Questionnaire and Interview

Semi-structured interviews and questionnaires were used during the data collection to obtain more information about the sea cucumbers, the benefits of the sea cucumbers to the local people, environmental issues and the management and conservation of sea cucumbers in Pulau Tinggi, Mersing. 15 questionnaires were distributed to the local people around Kampung Tanjung Balang. The selection of the 15 respondents was done randomly. The questionnaire was divided into five parts, (i) the demographic profile of each respondent such as gender, age, marital status and occupation, (ii) the information about sea cucumbers in Pulau Tinggi, (iii) the information about the benefits of the sea cucumbers to the local people, (iv) threats to the sea cucumbers and their habitats, and (v) management and conservation of the sea cucumbers and their habitats.

Results and Discussion

In terms of species identification based on the sea cucumber's physical appearance, the present study recorded ten species of sea cucumber from one order comprising two genera (Figures 2 to 11). Among the total number of sea cucumbers collected from Pulau Tinggi, five species were under the Holothuria while another five belonged to the genus *Stichopus* (Table 1). The most prevalent species in Pulau Tinggi is *Holothuria (Mertensiothuria) leucospilota*. The most prevalent species in Pulau Tinggi is *Holothuria (Mertensiothuria) leucospilota*, often known as bat puntil or white threads fish, as it was documented and observed at all collection sites around the Shaz Resort Pulau Tinggi Sdn. Bhd. to Kampung Tanjung Balang area. Previously, *H. leucospilota* was reported as the most widespread species in Malaysia (Kamarudin *et al.*, 2009; Kamarudin *et al.*, 2015).

Table 1: Species list of sea cucumber in Pulau Tinggi, Johor

Order and Class	No.	Species	Local Name (Kamarudin, 2015)
Order Aspidochirotida Family Holothuridae	1	<i>Holothuria (Mertensiothuria) leucospilota</i>	Bat puntil/White threads fish
	2	<i>Holothuria (Mertensiothuria) hilla</i>	Bat/Tiger tail sea cucumber
	3	<i>Holothuria (Lessonothuria) pardalis</i>	Bat
	4	<i>Holothuria (Stauropora) fuscocinerea</i>	Ashy pink sea cucumber
	5	<i>Holothuria (Lessonothuria) verrucosa</i>	Bat
Order Aspidochirotida Family Stichopodidae	6	<i>Stichopus rubermaculosus</i>	Gamat
	7	<i>Stichopus chloronotus</i>	Talifan varieti hitam/Greenfish
	8	<i>Stichopus horrens</i>	Gamat/Dragonfish
	9	<i>Stichopus vastus</i>	Gamat batu/Gamat kiulu
	10	<i>Stichopus ocellatus</i>	Gamat/Eye-spotted sea cucumber

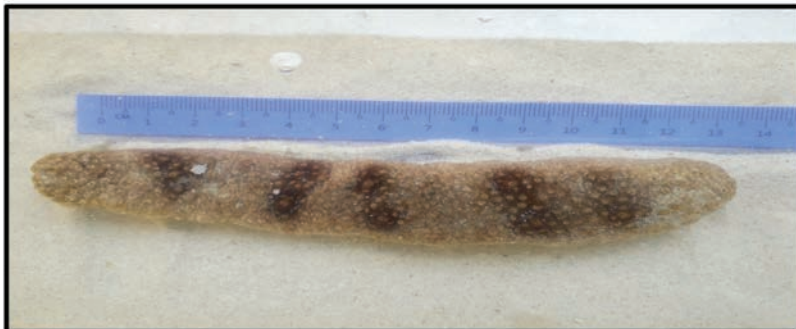


Figure 2: *Holothuria (Stauropora) fuscocinerea*



Figure 3: *Holothuria (Mertensiothuria) hilla*

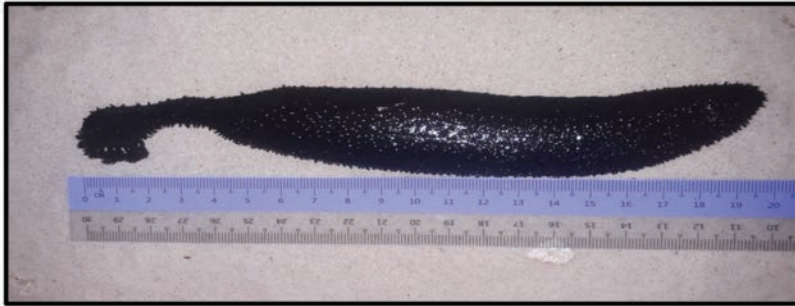


Figure 4: *Holothuria (Mertensiothuria) leucospilota*



Figure 5: *Holothuria (Lessonothuria) pardalis*



Figure 6: *Holothuria (Lessonothuria) verrucosa*



Figure 7: *Stichopus chloronotus*

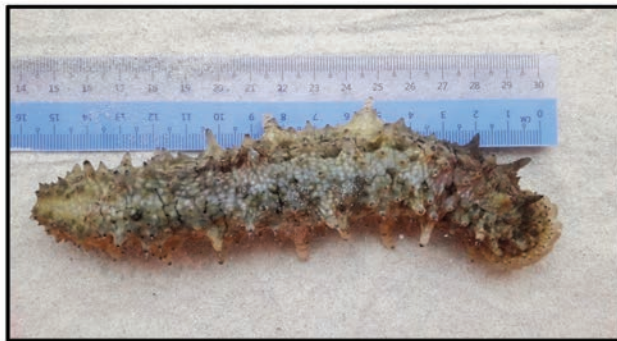


Figure 8: *Stichopus horrens*



Figure 9: *Stichopus rubermaculosus*



Figure 10: *Stichopus vastus*



Figure 11: *Stichopus ocellatus*

In general, nine types of ossicle shapes were observed in Pulau Tinggi specimens: Spider shape, anchor shape, boomerang shape, button shape, C-rod shape, I-rod shape, perforated shape, rosette shape and table shape (Table 2). The absence of some common ossicle shapes in this study, for example, the absence of several ossicle shapes in *Stichopus chloronotus* specimen (Table 2) could be due to handling errors during the ossicle extraction and slide preparation for microscopic observation. However, the species identification based on its physical appearance confirmed its status as *S. chloronotus* or the greenfish (Purcell *et al.*, 2012). The presence of additional and rare ossicle shapes in some species, for example, the observation of spider-shaped ossicle in *Stichopus rubermaculosus* specimen requires further research with more specimens from Pulau Tinggi. Kamarudin *et al.* (2018) reported the presence of an uncommon ossicle shape, i.e., spider-shaped rod in *H. leucospilota* from Teluk Nipah, Pangkor Island, Perak.

Local people usually catch sea cucumbers during low tide day and night. Sea cucumbers are very sensitive to light; therefore, it was easy to track them. The villagers used sea cucumber for medication in the form of capsules and gamat oil to treat external and internal wounds, especially for the women after giving birth, by speeding up the recovery of the wound. Sea cucumbers were also used as a source of income by producing gamat-based products.

Furthermore, rubbishes affect the habitat of sea cucumbers since sea cucumbers are sensitive to polluted environments. Lower species diversity of sea cucumbers is thought to be mostly caused by pollution from anthropogenic threats such as places for boat routes that endanger the ecosystem. It is believed that overfishing for economic gain and the great demand for sea cucumbers are to blame for the declining wild sea cucumber population. According to the local people, among the conservation efforts that can be taken to sustain the high diversity of sea cucumber in Pulau Tinggi are by applying cage breeding method, continuous monitoring and law enforcement by the local authorities, and more local people should be encouraged to take part in the management and conservation of sea cucumbers and their habitats.

Conclusion

During the present study, ten species of sea cucumber were found in the coastal area of Pulau Tinggi. There were five species from the genus *Holothuria* which are *Holothuria (Mertensiothuria) leucospilota*, *Holothuria (Lessonothuria) pardalis*, *Holothuria (Mertensiothuria) hilla*, *Holothuria (Lessonothuria) verrucosa* and *Holothuria (Stauropora) fuscocinerea* and five species from the genus *Stichopus* which are *Stichopus rubermaculosus*, *Stichopus chloronotus*, *Stichopus horrens*, *Stichopus vastus* and

Table 2: List of ossicle shapes in the sea cucumber specimens from Pulau Tinggi, Johor

Specimen	Table Shape	C-shaped Rod	Perforated Plate	Rosette	I-shaped Rod	Button Shape	Boomerang Shape	Anchor Shape	Spider Shape
<i>Holothuria (Mertensiothuria) leucospilota</i>	√	x	x	x	x	√	x	x	x
<i>Holothuria (Mertensiothuria) hilla</i>	√	√	x	x	√	√	x	x	x
<i>Holothuria (Lessonothuria) pardalis</i>	√	x	x	x	x	√	x	x	x
<i>Holothuria (Stauropora) fuscocinerea</i>	x	x	x	x	√	√	x	x	x
<i>Holothuria (Lessonothuria) verrucosa</i>	√	x	x	x	√	√	x	x	x
<i>Stichopus rubermaculosus</i>	√	x	√	x	x	x	√	√	√
<i>Stichopus chloronotus</i>	√	x	x	x	x	x	x	x	x
<i>Stichopus horrens</i>	√	√	x	√	x	x	x	x	x
<i>Stichopus ocellatus</i>	√	√	x	√	x	x	√	√	x
<i>Stichopus vastus</i>	√	√	x	√	√	x	x	√	x

Stichopus ocellatus. Nine types of ossicle shapes were extracted from the sea cucumber specimens of Pulau Tinggi, which were table shape, perforated plate, C-shaped rod, rosette shape, button shape, I-shaped rod, boomerang shape, anchor shape and spider shape. All the parties including villagers and local authorities should work together to protect sea cucumbers, especially in marine parks to prevent the extinction of marine life in the area and to maintain the status of marine parks in Malaysia. This documentation can help preserve the data for future researchers to conduct further study Pulau Tinggi.

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