

The Diversity and Distribution of Holothuroidea in Pulau Aur, Johor

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ABSTRACT

An investigation at Pulau Aur, Johor was done using the wandering transect with scuba gears to re-appraise the local holothuroid diversity and distribution. Results showed that three families, eight genera and 20 species of sea cucumbers were recorded in the 13 locations surveyed in Pulau Aur, Pulau Dayang, Pulau Lang and Pulau Pinang from 5th to 12th September 2005. The dominant family was Holothuriidae (12 species), followed by Stichopodidae (5 species). The most dominant species in these four islands were *Holothuria edulis* and *Stichopus chloronotus* which could be found abundant on the sand substrate and rubble area from a wide range of depth (4.0 m – 20.0 m). Eleven of the species found were new locality records in the study sites. Recent publications only recorded 13 species in Pulau Aur. Pulau Aur, Pulau Dayang and Pulau Pinang exhibited a high diversity of sea cucumber populations (12 species found in each island), while only 6 species of sea cucumbers were recorded in Pulau Lang. With these results, we hope to provide better information and model for conservation purpose with the data collected in the marine park (as a control area) where sea cucumber fishery is prohibited and all the marine resources are protected.

Keywords: Diversity, distribution, Holothuroidea, sea cucumber, Pulau Aur.

Introduction

Sea cucumber fisheries are growing worldwide, leading to overexploitation in most tropical Indo-Pacific countries (Conand, 1999, 2004). For that reason, FAO recently held a symposium on the exploitation, management and aquaculture of sea cucumber (Lovatelli *et al.*, 2004) and CITES has also focused attention on the conservation of these animals at a meeting in Malaysia, 2004. Symposium and CITES do not bring a positive impact on

the conservation of sea cucumbers in Malaysia because sea cucumber fishery is the main source of livelihood in some areas, like Sabah, with over 1600 km of coastline, and there are no regulation and rules on its sea cucumber fisheries (Baine & Choo, 1999). The high values of the sea cucumber species, the ease to harvest from shallow water, and their vulnerable nature from the sea contribute to the overexploitation in the Malaysian waters.

The Pulau Aur group is a tropical offshore island, 67 km east of Mersing, Johor. The group comprises several islands, namely Pulau Aur, Pulau Dayang, Pulau Pinang and Pulau Lang. Both the Pulau Aur group and Pulau Pemanggil which is 15 km northwest of Pulau Aur, belong to the Johor Marine Park. Most of the rocky islands are well forested and have isolated coconut plantations. With deep, clear water, healthy corals and regular encounters with large pelagic species, these islands have the potential to become international diving locations.

The Pulau Aur group was selected as the survey location of sea cucumbers because the islands in the lower part of the South China Sea were designated as marine parks (Pulau Besar, Pulau Aur and Pulau Tinggi). Here, sea cucumber fishery is prohibited and all the marine resources are protected. The results of the survey will provided real images of the diversity and distribution of sea cucumbers in their natural habitat. Furthermore, the results will provide references and information for the conservation purpose of these sea cucumbers in other places in Malaysian waters.

Materials and Method

Thirteen reefs, which are located around Pulau Aur Archipelago, Johor, were surveyed using the wandering transect method (Figure 1 & Table 1). The observation of sea cucumber species in the study sites was done using scuba diving to depths of 0 – 30 m. The methods used were mainly qualitative, since it was unrealistic to carry out quantitative surveys on all the sites within the available time. The survey was conducted both during night and day since most of the sea cucumber species are nocturnal.

After some initial exploratory dives, a checklist of the commonly seen sea cucumber species was drawn up on a matt-surface rigid diving slate. The list was continually updated as more reefs were investigated. Distances of survey area were recorded and the numbers of the same species were converted into Relative Abundance unit (individual per 100 m²). Colour photographs of living specimens were taken after the specimens were transferred to a container filled with seawater for relaxing purpose and to achieve a natural body form. Good colour photographs of living organisms taken with scale are of particular important when identifying species, since preserved materials often lose colour and shape.

Results

The results of the surveys are shown in Table 2. Three families, nine genera and 20 species were recorded in the study sites. The dominant family found was Holothuriidae

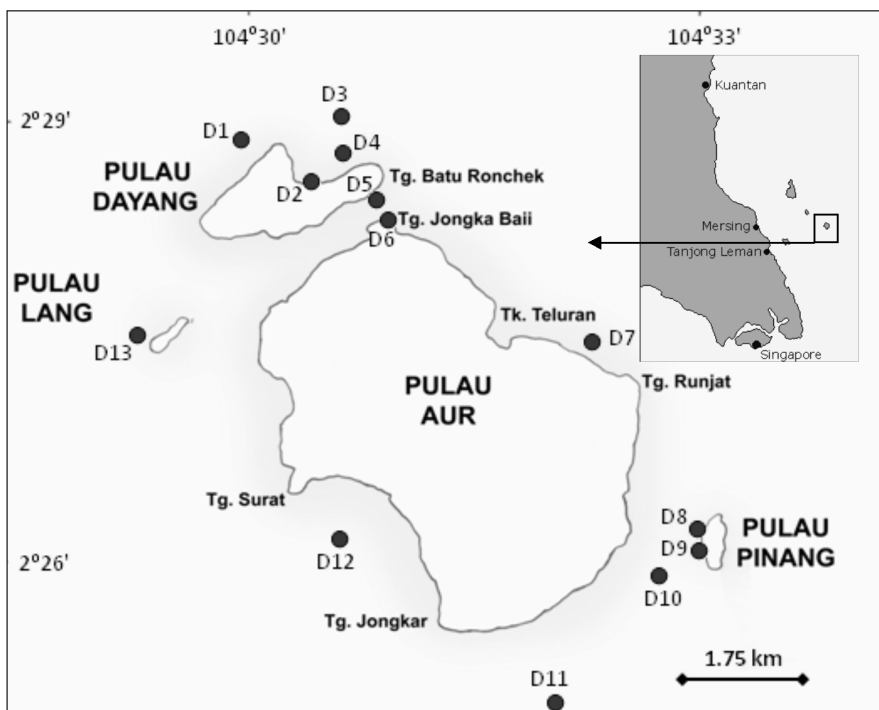


FIGURE 1: The Sampling Location in Pulau Aur

(12 species) followed by Stichopodidae (5 species). The most common genus observed is *Holothuria* spp. (5 species), followed by *Actinopyga* spp. (4 species). The most abundant or common sea cucumber recorded were *Stichopus chloronotus* and *Holothuria edulis* which were found on sandy bottom, rocky and rubble areas in ten of the surveyed reefs. *S. hermanni variegates*, *S. horrens*, *Actinopyga* sp., *Bohadschia marmorata*, *Holothuria hilla*, *H. nobilis*, *Eupta godeffroyi*, *Synapta maculata* and *Synaptula lamperti* were considered rare species because they were respectively from one location.

From the four islands surveyed in the Aur group, Pulau Dayang, Pulau Pinang and Pulau Aur exhibited higher biodiversity of sea cucumber population compared to Pulau Lang in this study (Figure 2). All seven genera of sea cucumbers recorded were found in Pulau Dayang and Pulau Pinang while six genera of sea cucumbers were recorded in Pulau Aur. We only found 4 genera and 6 species of sea cucumbers inhabiting Pulau Lang, which was the smallest island in the Aur Archipelago located at the west of the main island.

Rayner's Rock of Pulau Dayang showed the highest biodiversity area of sea cucumber in Pulau Dayang in which six genera and seven species of sea cucumbers were found (Figure 3). Meanwhile only one species of sea cucumber was recorded in Teluk Jawa. The Tanjung Bercium and south-western sampling locations in Pulau Pinang were considered rich in sea cucumbers diversity where five genera and seven species were recorded from both sites compared to the other study sites in this island. No sea

TABLE 1: The Latitude and Longitude of the Sampling Location in Pulau Aur Group

Code	Location name	Latitude / Longitude	Area coverage (m ²)	Depth (m)
D1	Pulau Dayang (North west)	2° 28' 54.0" N 104° 29' 55.8" E	40	15
D2	Pulau Dayang (North)	2° 28' 43.5" N 104° 30' 11.8" E	100	12
D3	Pulau Dayang: Rayner's Rock	2° 28' 55.0" N 104° 30' 20.9" E	30	19
D4	Pulau Dayang (North): Teluk Jawa	2° 28' 42.2" N 104° 30' 15.3" E	150	11
D5	Pulau Aur (North)	2° 28' 30.0" N 104° 30' 47.5" E	50	12
D6	Pulau Aur (North): Teluk Kador	2° 28' 19.4" N 104° 30' 46.8" E	50	12
D7	Pulau Aur (East)	2° 27' 32.4" N 104° 31' 49.2" E	50	12
D8	Pulau Pinang (West): Tanjong Bercium	2° 26' 17.6" N 104° 32' 38.6" E	50	25
D9	Pulau Pinang (West)	2° 26' 05.7" N 104° 32' 38.6" E	30	20
D10	Pulau Pinang (Southwest)	2° 28' 02.2" N 104° 32' 39.3" E	100	19
D11	Pulau Pinang: Pinnacles 1	2° 25' 09.0" N 104° 31' 59.9" E	100	30
D12	Pulau Aur (Southwest): Teluk Dalam to Tanjong Jongkar	2° 26' 03.7" N 104° 30' 42.6" E	200	18
D13	Pulau Lang – Tanjong Lang	2° 27' 39.9" N 104° 29' 08.1" E	50	10

TABLE 2: List of Sea Cucumbers Recorded in Pulau Aur Group

Family	Genus	Species	Pulau Dayang				Pulau Pinang				Pulau Aur				Pulau Lang	Total
			D2	D4	D1	D3	D8	D9	D11	D10	D7	D5	D6	D12		
Stichopodidae	<i>Stichopus</i>	<i>S. chloronotus</i>	X	X	X	X	X			X	X	X	X	X	X	10
		<i>S. hermanni</i>												X		1
		<i>variegatus</i>														1
	<i>Thelenota</i>	<i>S. horrens</i>	X										X			2
		<i>T. anax</i>								X				X		4
Holothuriidae	<i>Actinopyga</i>	<i>T. ananas</i>	X			X			X	X	X	X				5
		<i>A. lecanora</i>				X		X				X	X			2
		<i>A. miliaris</i>					X				X					5
	<i>Bohadschia</i>	<i>A. obesa</i>					X	X	X	X			X	X		1
		<i>A. sp.</i>						X								9
		<i>B. argus</i>	X		X	X	X	X	X		X	X	X	X	X	1
		<i>B. marmorata</i>														1

continue from page 17

<i>Holothuria</i>	<i>H. atra</i>			X	X	X	X		X		X		X		6
	<i>H. edulis</i>	X		X	X	X	X	X		X	X	X	X		10
	<i>H. hilla</i>		X												1
	<i>H. nobilis</i>										X				1
	<i>H. pulla</i>	X		X											2
<i>Pearsonothuria</i>	<i>P. graffei</i>		X	X	X		X	X		X	X				4
Synaptidae	<i>Eupta</i>			X											1
	<i>Synapta</i>			X											1
	<i>Synaptula</i>					X									1
Total number of species per site		6	1	8	7	7	6	0	7	3	5	3	9		6
Total number of species per island		12	12	12	6										

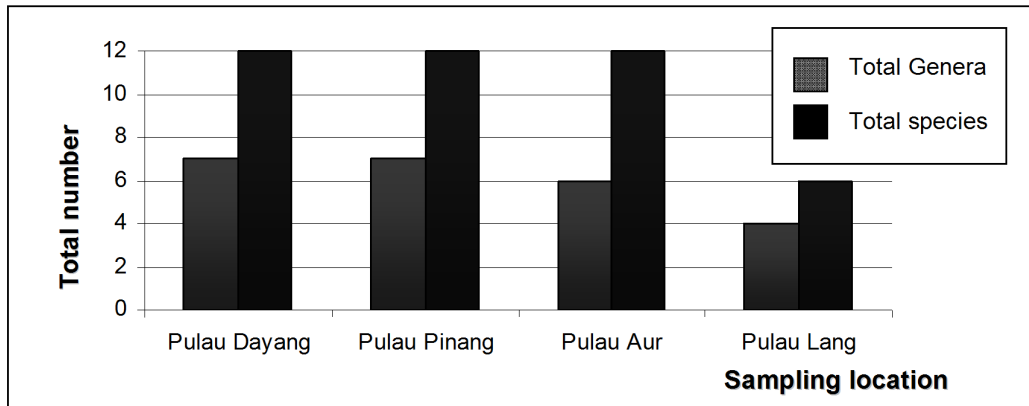


FIGURE 2: Total Number of Genera and Species of the Sea Cucumbers (Holothuroidea) Collected from the Four Different Islands of the Pulau Aur Group

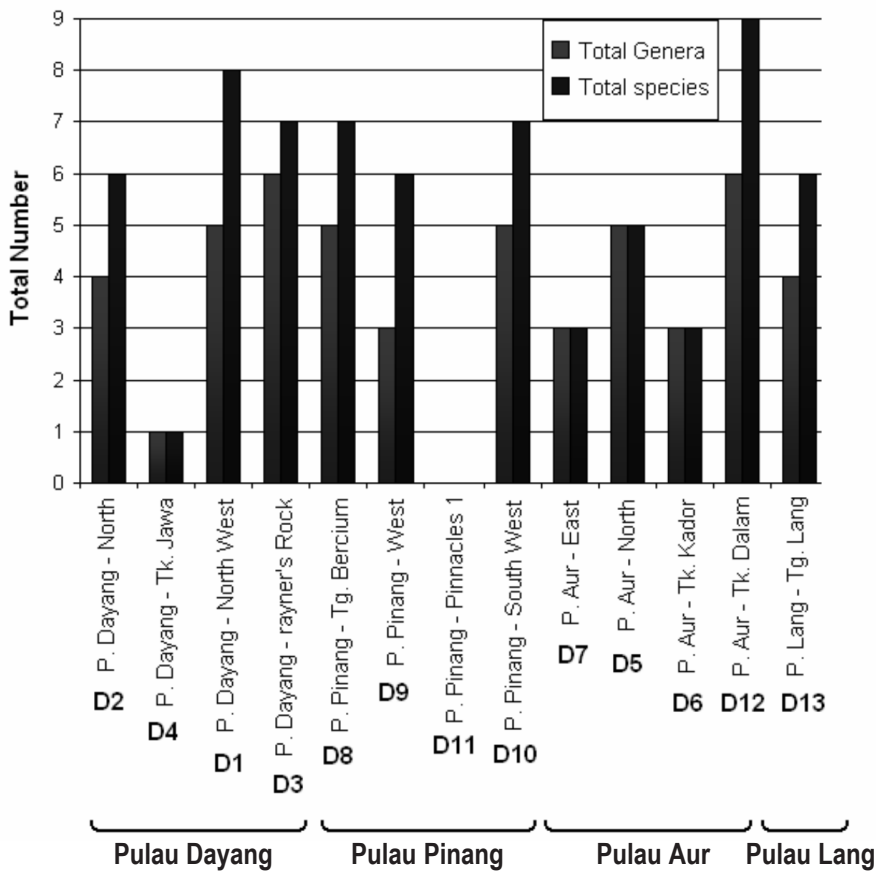


FIGURE 3: The Total Number of Genera and Species of the Sea Cucumbers (Holothuroidea) Collected from the Different Reefs from Pulau Aur Group

cucumber was found in Pinnacles 1. At Pulau Aur, which was the main island in the group, six genera and nine species of sea cucumbers were found in areas between Teluk Dalam to Tanjong Jongkar, which is located at the southwestern part of the island. This area showed the highest biodiversity of sea cucumbers among the 13 sampling locations in Pulau Aur Archipelago. Only one location was surveyed in Pulau Lang due to the size of the island. Four genera and six species of sea cucumbers were found in this island.

Discussion

The Pulau Aur group is the outermost island of the Johore Archipelago and has been designated as a marine park situated on the east coast of Peninsular Malaysia. It is unaffected by runoff from rivers of the peninsular coast and therefore exhibits diverse and developed coral communities.

Previous survey of sea cucumber diversity in the Pulau Aur group (Zulfigar & Tan, 1999) recorded six genera and 13 species of sea cucumbers, with *Holothuria* (4 species) formed the dominant genus, followed by genus *Bohadschia* (3 species). This study recorded 20 species of sea cucumbers in three families and nine genera at the study sites. Eleven of the species (*S. horrens*, *A. lecanora*, *A. miliaris*, *A. obesa*, *Actinopyga* sp., *H. hilla*, *H. nobilis*, *H. pulla*, *Eupta godeffroyi*, *S. maculata* and *S. lamperti*) were never been reported from the study sites before. *A. echinites*, *Bohadschia* sp.1, *Holothuria* sp.1 and *Holothuria* sp.2, which were recorded by Zulfigar & Tan (1999) in Pulau Aur group were not found during this survey. The results in this survey were similar to the report by Zulfigar and Tan (1999), in that the most dominant species in Pulau Aur Archipelago was *H. edulis*, which was found abundant on the sandy substrate at a wide ranged of depth. The results in this survey showed that *S. chloronotus* was also one of the dominant species, similar to *H. Edulis*, which was found in 10 of the reefs surveyed in the Pulau Aur Archipelago.

Most of the locations with the highest diversity of sea cucumbers in were located in bay area. Hard coral colonies from *Acropora* spp. provided the best habitats for *P. graffe* in the North West and Rayner's rock, which are a group of rocky outcrops located at the western entrance of the straits in Pulau Dayang. The coral rubble and debris that accumulated at the base of these rocks were the best nesting area for *Holothuria* spp. Only one species of sea cucumber was recorded in Teluk Jawa, whose reef is more developed on the north coast of Pulau Dayang especially within the large bay area of Teluk Jawa. The terrestrial granite slopes, coral rubble and sand, before the reef sloped into deeper waters provided the best hiding place and food for *S. chloronotus*, which was the only sea cucumber species found here. *S. horrens* was only found in Pulau Dayang, which occupied areas scattered with boulders of *Porites* sp. for hideout during the day. This species also foraged on the soft sandy area around the boulder corals. Most of the species from Family Synaptidae were found on rocks and rubbles substrate at only the north western part of this island.

No sea cucumber was found in Pinnacles 1, where the submerged reefs were located at the southern part of Pulau Aur. This might be due to the strong underwater current and no hiding area because this area does not support high coral cover, except

the occasional tabulate *Acropora* and encrusting species *Porites* and brain corals. Most of the sea cucumbers were found in the Tanjung Bercium and South Western Pulau Pinang, located at the straits between Pulau Aur and Pulau Pinang. Strategic locations covered by two islands provided the best hiding and nesting places for species such as *Actinopyga* spp. and *Bohadschia* spp. The bay located at the South-western part of Pulau Aur (Teluk Dalam to Tanjong Jongkar) also exhibited high diversity of sea cucumbers compared to other locations in this island because the area was protected when monsoonal waves hit the coast. High commercial value species such as *S. hermanni variegatus* were found at the rocky and sandy area at this area.

Pulau Lang, the smallest island in the Pulau Aur Archipelago, lies to the west of the main island and is a granite outcrop elongated in a northeast to south west direction. The entire reef on this island can be classified as escarpment reefs with steep slopes to the sea bottom. Stunted hard coral colonies were found in shallow areas with sporadic growth on the shoulders of the submerged granites rocks. Soft corals and sponges were interspersed with the more dominant encrusting corals and coralline rubble. The island itself is exposed to the southwest monsoon, and reef development is relatively poor. Only the common sea cucumbers from Order Aspidochirotida like *S. chloronotus*, *H. atra*, *H. edulis*, *A. obesa* and *B. argus* were found in the rocky and rubble area here.

In conclusion, only a few species of sea cucumber were found in specific habitats such as Family Synaptidae, which was only found on sponges at the north western part of Pulau Dayang. *S. horrens* was the rarest species which was only found in the north part of Pulau Dayang, in areas scattered with boulders of *Porites* sp. suitable for hiding during the day time. The remaining species were found among the sandy bottom, rubble and rocky areas along the islands. Most of the sea cucumbers in the Pulau Aur group were found at the fringing reefs and only a few sea cucumber populations were established in the encampment reefs, especially in Pulau Lang and Pulau Pinang. No sea cucumber was observed in the submerged reefs. The topography factors, such as the bay and the monsoonal waves, might play an important role in the distribution of the sea cucumbers in the Pulau Aur group.

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