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SEAGRASS AT SOUTH WESTERN COAST OF JOHOR

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Abstract: Study on distribution of seagrasses was carried out at south western coast of Johor, Malaysia. At present, the study area is facing rapid economic growth. Hence, competition between development and preservation of natural ecosystem becomes a major issue. Since the last investigation on seagrasses was conducted 5 years ago, this reassessment is important to evaluate the seagrasses occurrence in the area. Investigation of the seagrasses distribution was conducted using quadrat transect method from January 2009 to December 2009 during spring low tide. Six species of seagrasses were found at the seagrass bed located at Tanjung Kupang–Merambong shoal. The seagrasses species were identified as *Enhalus acoroides, Thalassia hemprichii, Halophila spinulosa, Halophila ovalis, Halophila minor* and *Halodule pinifolia*. Only one species of seagrass; *Thalassia hemprichii* was identified at Merambong Island whereas two species were identified at Pulai River estuary i.e. *Enhalus acoroides* and *Halophila ovalis*. At Tanjung Kupang, the seagrasess grow and form dense communities compared to seagrasses at Pulai River estuary which only grow sparsely near the shoreline. Comparatively, seagrass at Merambong Island was only found in small patches. Overall the present study is able to update the occurrence of seagrass species at the south western coast of Johor.

KEYWORDS: *Johor south western coast, occurrence, seagrass species*

Introduction

Seagrasses belong to Angiosperms which are unique flowering underwater plants that are capable of growing in marine, fully saline environments. These plants mostly grow on silty or sandy sediment in shallow coastal waters as they require enough sunlight for photosynthesis. Some species could be found in marine or estuarine waters deeper than 10 m from the surface as long as the environment is clear and photic (Choo, 2006). Generally, healthy seagrass meadows are regarded as a key factor for sound marine ecosystem as they provide habitat, nursery-ground and primary food source for fish, invertebrates and gastropods. Seagrasses also contribute to protect coastlines against erosion and stabilizing bottom substratum through the physical characteristics of their leaves and root-rhizome systems (Phillips and Menez 1988; Roushon *et al*., 2009).

Seagrasses require plenty of sun, acceptable salinity, temperature, and nutrient supply to grow. Changes of these factors could contribute to the declination of seagrass population (Waycott *et al.,* 2005). Mann (2000) reported that seagrasses are physiologically adjusted for survival in seawater which involve adjustment to live in saline medium and completely submerged. They can tolerate salinity between 4 to 65 parts per thousand and the salinity of 35 parts per thousand is the best condition to grow. Moreover 4.4 to 29 % of surface light is required by the seagrasses in order to perform photosynthesis process (McKenzie, 2008). Other essential needs by seagrasses for growth are inorganic carbon, nitrogen and phosphorus. Higher nutrient is necessary during growing season but it become toxic at senescent season. Furthermore, tidal currents play important role especially for pollination purposes and gases exchange from water to plant (Clement *et al.,* 2001). Factors such as the photosynthetic rate of seagrasses depend on the thickness of the diffusive boundary layer that is determined by current flow, as well as the sedimentation

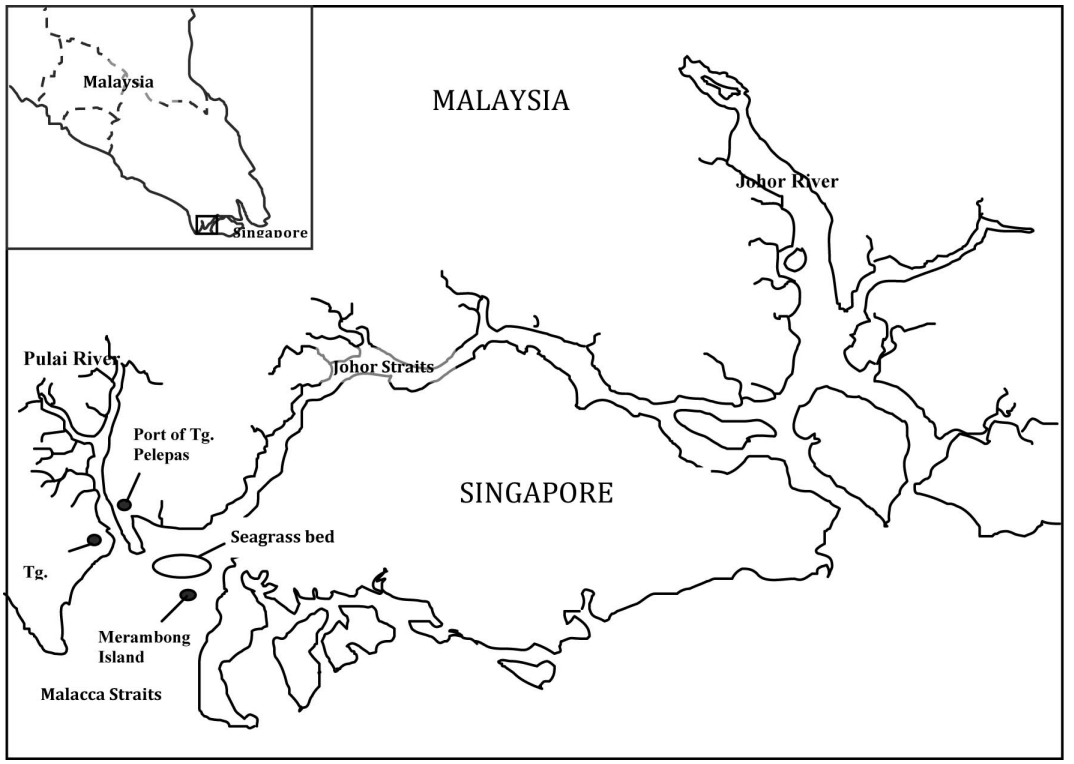

Figure 1: Map of study area showing seagrass bed that is located between Merambong Island and Tanjung Kupang. Tanjung Bin is at the estuary of Pulai River, Johor.

rate. Both condition influence growth rates of seagrass, survival of seagrass species and overall meadow morphology (Rasheed *et al*., 2007).

Currently, there are approximately 60 species of seagrasses in 12 genera identified worldwide. In Malaysia, fourteen seagrass species have been identified i.e. *Cymodocea rotundata, C. serrulata, Enhalus acoroides, Halophila beccarii, H. decipiens, H. ovalis, H. minor, H. spinulosa, Halodule pinifolia, H. uninervis, Ruppia maritima, Syringodium isoetifolium, Thalassia hemprichii, ,* and *Thalassodendron ciliatum* (Edang *et al*., 2008). There are 78 known habitats of seagrass including mangroves, coral reefs, shallow intertidal zones, semi-enclosed lagoons and shoals (Bujang *et al.,* 2006). The largest seagrass bed in Peninsular Malaysia is in Tanjung Kupang seagrass bed, which lay between Merambong Island and Tanjung Kupang with an approximate size of 38 hectares (Fig. 1). Previous studies reported that Tanjung Kupang seagrass bed had the highest diversity in seagrass species. Ten species out of the known authigenic fourteen species in Malaysia were observed to form the seagrass bed. The species reported were *Enhalus acoroides, H. ovalis, H. minor, H. spinulosa, Halodule pinifolia, H. uninervis, Cymodocea rotundata, C. serrulata, Thalassia hemprichii* and *Syringodium isoetifolium* (Bujang *et al*., 1999; 2006; Choo, 2006).

In general, disappearance of a seagrass bed can be due to natural or man-induced influences, or both. Herbivores, cyclones, typhoons and tidal waves are the examples of the natural threats (McKenzie, 2008). Increased turbidity in water due to any natural cause could also be a threat. Among anthropogenic activities that contribute to the decline of seagrasses is pollution that increases coastal runoff and discharge of sewage (Ooi *et al*., 2011). Inflow of inorganic and organic suspended matters could be a direct impediment.

Table 1: Location and coordinate of sampling stations.

Location	Coordinate	
	Longitude	Latitude
Tanjung Kupang seagrass bed	N 01° 19' 50.9"	E 103° 35' 51.6"
Merambong Island	N 01° 19' 1.1"	E 103° 36' 25.5"
Pulai River	N 01° 20' 24.3''	E 103° 32' 36.9''

Farmland runoff and discharge of raw sewage, both are rich in nitrogen and phosphorus could impose an indirect negative impact as raised concentrations can cause eutrophication and result in increased concentration of suspended matters (planktons). Other ways include physical destruction of the habitats by dredging, boat propellers and anchoring, among others. If only the leaves and above ground vegetation are harmed by such physical impacts, the seagrasses are often capable of recovering from the inflicted damage within a few weeks. However, when the roots and rhizomes are disturbed, the ability of the plant to re-grow is severely impaired and it may never be able to recover from the damage (Kaiser *et al*., 2005).

In recent years, southwest coast of Johor is experiencing a rapid economical development due to the industrialisation which sometimes conflicts with preservation of the natural ecosystem. As shown in Figure 1, Tanjung Kupang, where the investigation was conducted, is located in the area within Iskandar Development Region (IDR). The economic zones of IDR include Port of Tanjung Pelepas (PTP) and Tanjung Bin power plant that are located on the banks of Pulai River. Future development plan in the area includes a petrochemical industry and a maritime industry. An oil bunker facility is currently under construction on the man-made island located approximately 2.1 km from the seagrass bed.

The seagrass bed is also located adjacent to Tuas, an industrial zone at the western part of Singapore consists of an incinerator plant, power generator and chemical industry. It is expected that development along the both sides of the seagrass bed will lead to significant changes in the surrounding environment (Zulkifli *et al*., 2010). With such threat facing seagrasses in the area, information regarding its occurrences and distribution are important for the purposes of conservation. Apparently, information of seagrasses in Southeast Asia is still limited although their roles in ecosystem are well recognized (Ooi *et al*., 2011). This study intends to report the latest occurrences of seagrasses in limited area between Tanjung Kupang and Merambong Island on the south western coast of Johor.

Materials and Methods

Study Area

The study was conducted at the south western coast of Johor at Pulai River estuary and the nearby adjacent marine water (Figure 1). There are two waterways that discharge runoff from inland water which are Pok River and Pulai River. Pulai River has been gazetted as Ramsar Site and is one of the largest riverine mangrove systems in Johor. The seagrass bed is located approximately 1.0 km southern of Tanjung Kupang and only appears during low tides at 0 to 0.2 m. Merambong Island is located 2.5km south of Tanjung Kupang and 1.0 km from west of Singapore. It is a small uninhabited island (0.3 hectares) and consists of sandy, rocky and mangrove beach.

Method of Sampling

This study was conducted from January to December in 2009 during spring low tide at three sampling locations as shown in Table 1. The collections of the seagrass specimens were conducted using quadrat transect method. Ten transect lines of 50 meter in length were placed at points where the habitat starts and ends. A distance of 25 meter between transects was maintained to avoid damage to the seagrass habitat and minimize interaction between transects. Quadrat (1 m x 1m) were set every 5 meter along the transect line to obtain

Table 2: Physical characteristic at sampling location.

Location	Physical Characteristic			
	Zone (m)	Temperature, °C	Salinity, ppt	Dissolved oxygen, mg/L
Tanjung Kupang seagrass bed	Inter-tidal	29.6 – 31.4	28.0 – 29.5	4.63 – 5.14
Merambong Island	Sub-tidal	29.4 – 30.6	28.0 – 29.0	3.92 – 4.76
Pulai River	Estuary	28.4 – 29.6	28.0 – 29.4	4.74 – 5.61
Tanjung Kupang seagrass bed	Inter-tidal	29.6 – 31.4	28.0 – 29.5	4.63 – 5.14

Table 3: Occurrence of seagrass at each sampling location.

Family	Species	Location		
		Tanjung Kupang seagrass bed	Pulai River estuary	Merambong Island
Hydrocharitacea	*Enhalus acoroides*	√	√	
Cymodoceaceae	*Halodule pinifolia*	√		
Hydrocharitacea	*Thalassia hemprichii*	√		√
Hydrocharitacea	*Halophila spinulosa*	√		
Hydrocharitacea	*Halophila ovalis*	√	√	
Hydrocharitacea	*Halophila minor*	√		

Note: "√" represents the seagrass species recorded at each location.

Table 4: Turbidity results at each sampling station.

Location	Turbidity (FTU)
Tanjung Kupang seagrass bed	4.03
Merambong Island	1.63
Pulai River	10.86

representative samples. Specimens within the quadrat were manually picked and brought back to the Environmental Engineering Laboratory, Universiti Teknologi Malaysia for sorting and identification. Water temperature and salinity were also recorded at each sampling location.

Results and Discussion

The seagrasses at Pulai River estuary grow sparsely near the shoreline compared to Tanjung Kupang which grows largely forming a bed. At Merambong Island only small patches of seagrasses were found growing near the northern part of the island.

Table 2 shows the physical characteristic of seawater recorded at each sampling station. The surface water temperature is in the range of 28.4 to 31.4°C which is the typical temperature of tropical waters with salinity from 28.0 to 29.5 ppt. The values are similar as reported at other coastal areas of Peninsular Malaysia which harboured seagrass (Bujang *et al*., 1999; Zakaria *et al*., 2003).

Seagrass specimens collected in this study were found to be a common species recorded in Malaysia coastal areas. The species can be identified according to the shapes and sizes of the leaf. *Thalasia* and *Halodule* leaves are shaped like a ribbon while *Halophila* have a paddle or fern shaped leaf.

The result obtained from this study show smaller number of seagrass species compared to previous study (Bujang *et al*., 2006). This is probably due to the different method of sampling and the shorter duration of study. The present study only collected seagrasses that emerge during spring low tides, while Bujang *et al*., (1999; 2006) collected seagrasses using snorkeling and SCUBA diving for four years from 1994 to 1997.

Table 5: Seagrass species at each location.

Location	Species	Description
Tanjung Kupang Seagrass bed	*Enhalus acoroides*	• Leaves 92 to 140 cm long • Leaves width range from 1.0 to 2 cm
	Halodule Pinifolia	• Leaves 11-12 cm long • 0.1 cm width of leaf blade • Bright green leaf
	Thalassia hemprichii	• Leaves 10-15 cm long • Width leaf blade, 0.4-0.8 cm
	Halophila spinulosa	• Fern like with dark green leaves • Have 10-15 pairs of oblong-linear leaflets • Serrated leaf margin • Leaves arranged opposite in pairs
	Halophila ovalis	• 12-15 pairs of cross vein at each leaf • Found widespread at seagrass bed
	Halophila minor	• Each leaf has 6-8 pairs of cross veins • Small oval leaf blade with stalk
Pulai River estuary	*Enhalus acoroides*	• Leaves 80- 130 cm long • Leaves width range from 1.0 to 2 cm
	Halophila ovalis	• 10 to 16 pairs of cross vein at each leaf
Merambong Island	*Thalassia hemprichii*	• Leaves 9-14.2 cm long • Width leaf blade, 0.4-0.7 cm

According to Bujang *et al*., (2006) there were 10 species of seagrass found inhabiting the calcareous sandy-mud sub-tidal shoal. However, only six species of seagrasses were identified in this study inclusive of *Enhalus acoroides, Thalassia hemprichii, Halophila spinulosa, Halophila ovalis, Halodule pinifolia* and *Halophila minor.* Table 3 illustrates the seagrass species that have been discovered during monitoring at each sampling location.

There was only one species of seagrass found at Merambong Island, identified as *Thalassia hemprichii.* They were found growing near the mangrove trees at the northern part of Merambong Island in coexistence with green algae, *Caulerpa sertularioides.* This area is mostly made-off sandy-muddy substrate which is suitable for the seagrasses. Bujang *et al.,* 2012 also reported that many seagrasses and seaweed in Malaysia are found in mangrove area with sandy and muddy substrate.

Two seagrass species was identified at Pulai River estuary i.e *Enhalus acoroides* and *Halophila ovalis.* Between this two species, *Enhalus acoroides* were more abundantly distributed along the river bank. Light or water depth could be factors that limit the growth of the seagrass in this area since the water at Pulai River is more turbid compared to other sampling stations (Table 4). McDermid and Edward (1998) also reported that *Enhalus acoroides* occurred as dominant species at Madolenihmw Harbor which have higher turbidity than others site at Nahpali Island. Table 5 summarizes the descriptions of each species of seagrass respective to their sampling locations.

Leaf of *Enhalus acoroides* is longer than the other species' leaves ranging from 80 to 140 cm. Leaves of this species are known to grow at longer length when they are not mixed with other species (Vermaat *et al.,* 2004). It can be characterized by its linear and dark green

leaves and thick rhizomes with long black hair and seed. *Thalassia hemprichii* has 10 to 15 cm long ribbon-like leaves with slight curve laterally. The widths of leaf blade were recorded from 0.4 to 0.8 cm. Meanwhile, the species of *Halophila ovalis* were bigger than *Halophila minor* with cross veins of 10 to 16 pairs and 6 to 8 pairs respectively. Both of these species has oval and spoon-shaped leaves and were widely scattered at the seagrass bed. Species of *Halodule pinifolia* has bright green leaves with 11 to 12 cm in length and 0.1 cm width. In Malaysia, *H. pinifolia* have been classified as long leaved variant with leaf length range from 6.0 to 16.6 cm (Zakaria *et al.,* 2003). Bujang *et al.,* (1999) also reported that this species were locally abundant and have potential to stabilize the coastline and improve water quality at a particular environment.

Conclusion

The present study provides an updated information on seagrasses at south western part of Johor where six species of seagrass were identified at the Tanjung Kupang seagrass bed. The seagrasses identified were *Enhalus acoroides, Thalassia hemprichii, Halophila spinulosa, Halophila ovalis, Halodule pinifolia* and *Halophila minor*. The number of seagrasses identified was less compared to previous study since the observation on seagrass species in this study only involved seagrass that emerge during spring low tide. Only two species of seagrasses were recorded along the river bank of Pulai River estuary, i.e. *Enhalus acoroides* and *Halophila ovalis*.

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