SHORT COMMUNICATION

Spatial and temporal variations in percentage cover of two common seagrasses at Sirinart National Park, Phuket; and a first step for marine base

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Abstract

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Percentage cover and distribution of two common seagrasses, *Thalassia hemprichii* (Ehrenb.) Aschers. and *Cymodocea rotundata* Ehrenb. Et Hempr. Ex Aschers., were studied in the dry and wet seasons. The study was carried out at three levels on sheltered, moderately exposed and very exposed sites on the coastline of Sirinart National Park, Thailand. One hundred and twenty samplings were investigated and recorded. Analysis of variance (ANOVA) revealed that there were significant differences in the percentage cover of *C. rotundata* among different degrees of wave exposure (*P*<0.01); and *T. hemprichii* was significantly influenced by interactions between seasons, shore levels and degrees of wave exposure (*P*<0.05). High sediment disturbance on the very exposed site was likely to influence the percentage cover and distribution of both seagrasses. This study provided baseline data for further work on ecological study and long term monitoring; and a first step to building up a '*marine base*'.

Key words : *Cymodocea rotundata*, *Thalassia hemprichii*, marine ecology and marine base

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บทคัดย่อ

อัญชนา ประเทพ
ความต่างของพื้นที่ และฤดูกาลต่อปริมาณหญ้าทะเล 2 ชนิด ณ อุทยานแห่งชาติสิรินาถ จ.ภูเก็ต และฐานข้อมูลเบื้องต้นสำหรับการสร้างศูนย์วิจัยนิเวศวิทยาทางทะเล
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การศึกษาปริมาณและการแพร่กระจายของหญ้าทะเล 2 ชนิด คือ *Thalassia hemprichii* (Ehrenb.) Aschers. และ *Cymodoncea rotundata* Ehrenb. Et Hempr. Ex Aschers. ณ อุทยานแห่งชาติสิรินาถ จ.ภูเก็ต โดยทำการศึกษาผลของปัจจัยทางกายภาพต่อปริมาณและการแพร่กระจายของหญ้าทะเล โดยปัจจัยที่ศึกษาต่างกันดังนี้ 1) ฤดูกาล (ฤดูร้อน ฤดูฝน) 2) ปริมาณคลื่นลม (บริเวณอับลม บริเวณได้รับคลื่นลมปานกลาง และบริเวณที่ได้รับคลื่นลมมาก) และ 3) ระยะทางห่างจากฝั่ง (น้ำขึ้นสูงสุด) (0-40 ม. 41-80 ม. และ 81-120 ม.) จากการสุ่มตัวอย่าง 120 ครั้ง พบว่า *C. rotundata* ได้รับอิทธิพลจากปริมาณคลื่นลมอย่างมีนัยสำคัญ ($p<0.01$) และ *T. hemprichii* ได้รับอิทธิพลร่วมจากทั้ง 3 ปัจจัยอย่างมีนัยสำคัญ ($p<0.05$) ความแตกต่างดังกล่าวอาจมีผลมาจากปริมาณตะกอนในมวลน้ำซึ่งได้รับอิทธิพลโดยทางอ้อมจากความแรงของคลื่นลม การศึกษานี้เป็นข้อมูลพื้นฐานสำหรับการศึกษานิเวศวิทยาขั้นสูง และการติดตามผลเชิงนิเวศวิทยาระยะยาว พร้อมกันนี้เป็นการสร้างฐานข้อมูลสำหรับศูนย์วิจัยนิเวศวิทยาทางทะเล

ภาควิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยสงขลานครินทร์ อำเภอหาดใหญ่ จังหวัดสงขลา 90112

Seagrasses are underwater flowering plants that form an important coastal habitat world wide, often occurring in vast meadows which provide nurseries, shelter, and food for a variety of commercially, recreationally, and ecologically important species. There are 12 genera, in which 48 species have been reported worldwide (Phillips and Menez, 1988), 16 species from the ASEAN region (Fortes, 1990); and 12 species in Thailand (Lewmanomont *et al*., 1996; Santisuk and Larsen, 2001) which support many endangered species such as turtles and dugongs. However, there have been only a few studies conducted on the species composition and distribution of seagrasses in Thailand (Changsang and Poovachiranon, 1994; Poovachiranon and Changsang, 1994; Lewmanomont *et al*., 1996; Meesawat *et al*., 1999; Nakaoka and Supanwanid, 2000). Moreover, no long term of monitoring seagrasses have been yet reported. Sharp increases of the sediment in the water column due to coastal developments, deforestation and erosion can cause dramatic changes to seagrasses and other marine communities (e.g. Airoldi *et al*., 1996; Duarte, 2001).

The ecological roles of seagrasses are very important, they filter estuarine and coastal waters of nutrients, contaminants, and sediments, and are closely linked to other communities e.g. coral reef and mangrove systems (Nybakken, 2001). Moreover, they provide habitats for a wide variety of marine organisms, both plants and animals. The relatively high rate of primary production in seagrasses drives detritus-based food chains, which helps to support many of these organisms (Adam and King, 1995). Due to the important roles of seagrasses, there is '*Seagrass*Net' which is a global monitoring program to investigate and document the status of seagrass resources world wide, which have been studied intensively in ASEAN water, but mostly in the Philippines (e.g.; Terrados *et al*., 1999a; Terrados 1999b; Durate *et al*., 2000; Agawin *et al*.,2001; Van Vierseen *et al*., 2001; Husan *et al*., 2002; Kamp-Nielsen *et al*., 2002; Lacap *et al*., 2002). However, more studies on a local scale are still needed, which would be an important baseline dataset for Thai seagrasses.

Physical factors such as wave action and desiccation are already known to play very important roles in the distribution and abundance of most intertidal marine organisms (Lewis, 1964), but only a few such studies have been made on seagrass communities (Nakaoka and Supanwanid, 2000). Thus, this study investigated the effects of degree of wave exposure and shore level on disribution and abundance of seagrasses at the Sirinart National Park, Phuket, Thailand. This will provide essential baseline information for further complex ecological study. In addition, this is a first step to build up baseline information for further long term monitoring by using Sirinart Marine Park as a '*marine base*'.

Materials and Methods

Study site and sampling

The study site was located at Koh Pling, Sirinart National Park, Phuket, South of Thailand (8º05'N, 98º17'E). Sampling sites were selected along the shoreline with different degrees of wave exposure: sheltered (S), moderately exposed (M) and very exposed (E), at Ban Sakuu. At the exposed area, organisms were directly exposed to the wave action, which was less in mid-exposed and sheltered areas due to protection by fringing reefs. The study was carried out during low tide when most grass beds were exposed. Six line transects were conducted among the different degrees of wave exposure within the grass beds, two lines each. Then each line was marked using A+B EpoPutty epoxy (ALTECO) fixing on the rocks individually. Three or four quadrats of 50 cm × 50 cm were sampled randomly at 40 m intervals at three shore levels: 0-40 m was upper level, 41-80 m was mid shore level and 81-120 m was lower shore level. The tidal range at Phuket was 0.8-3.8 m in 2002; mean sea level was about 2.3 m (calculated from the Tide Table of the Hydrographic Department, Royal Thai Navy). Samples were monitored and recorded in two seasons: a dry season predominated by the NE Monsoon and a wet season predominated by the SW Monsoon. Dry season study was conducted during 6-8 May 2002 and wet season study was conducted during 4-6 October 2002. This brought up to 120 samples for this study. Percentage cover and substrates of *Cydomocea* and *Thalassia* were estimated visually and recorded at the site. Macrophyte specimens were collected and taken to the laboratory for species identification using Common Seaweeds and Seagrasses of Thailand (Lewmanomont and Ogawa, 1995) and Flora of Thailand (Santisuk and Larsen, 2001).

Statistical analysis

Two-way ANOVA was employed to test percentage cover of each species against different sites and seasons. Multiple comparisons were tested when there were significant differences between treatments, following Zar (1984). Cochran's C- test was used before each analysis, to test whether variances were homogeneous and square-root transformation was applied when necessary. Tukey multiple comparison was employed to test the differences between sites and seasons.

Table 1. Analysis of variance on mean percentage cover of *Thalassia hemprichii* and *Cymodocea rotundata* at Koh Pling, Sirinart National Park, Phuket. *P<0.05, **P<0.01, ***P<0.001

Source of Variation	df	*Thalassia hemprichii*		*Cymodocea rotundata*	
		MS	*F*	MS	*F*
Season: S	1	365.02	0.46	0.01	0.99
Shore level: SL	2	2161.71	0.04*	41.81	0.79
Degree of exposure: EX	2	2338.87	0.35*	933.84	0.006**
S × SL	2	589.87	0.41	68.89	0.67
S × EX	2	318.60	0.62	2.44	0.99
SL × EX	2	3781.95	0.0004***	34.88	0.94
S × SL × EX	4	2235.20	0.014*	75.71	0.78

Results

Species composition and distribution

Two species of seagrasses were found mixed together along the transect lines on coarse sand, *Thalassia hemprichii* and *Cymodocea rotundata*. *C. rotundata* was recorded mostly on the sheltered area than the other sites. While, *T. hemprichii* was widely distributed at all sites. Also, it is worth noting that there were common brown algae, *Padina* spp., found on the dead corals or rock within and nearby the grass beds.

Spatial and temporal variations in populations

There was variation in the percentage cover of *T. hemprichii* and *C. rontundata* amongst sites and seasons. *T. hemprichii* was the most dominant macrophyte at the study area, while *C. rotundata* was sparse and occurred mainly on the sheltered shore. Both seagrasses, however, had very little seasonal change, but they were significantly influenced by shore level and degree of exposure (Table 1). *T. hemprichii* was widely distributed along the shore, the highest percentage cover was 85.56% on the high shore of the mid exposed area during the dry season (Figure 1). *C. rotundata* was significantly more abundant on the sheltered shore than at the other sites, the highest percentage cover was only 14.16%. (Figure 2, Table 1).

Discussion

This study was the first study to investigate species diversity, distribution, spatial and temporal variations of seagrasses; and it was an attempt to build up baseline data for long term marine ecological study by using Sirinart National Park as a '*marine base*'. Two species of seagrasses were found at the study site, *T. hemprichii* and *C. rotundata*. They are commonly found along the Andaman sea coast of Thailand (e.g., Changsang and Poovachiranon, 1994; Meesawat *et al*., 1999; Lewmanomont and Supanwanid, 2000; Nakako and Supanwanid, 2000); and they are two of the most common species in South-East Asain seagrass meadows (Terrados *et al*., 1999b).

Both seagrasses were very patchy, the area cover of *T. hemprichii* was 0.043 km^2 - 0.069 km^2 and *C. rotundata* was 0.017 km^2. The area cover of *T. hemprichii* was two times greater eight years previously, when compared to the study by Changsang and Poovachiranon (1994). However, there was no record of *C. rotundata* in 1994. Thus, *C. rotundata* was likely to have dispersed from nearby areas and have established a new community recently. To my knowledge, there are only a few studies on propagule dispersal of seagrasses (e.g., Lacap *et al*., 2000). Therefore, further study on propagule dispersal and recruitment of seagrasses are needed for further understanding in their distribution and establishment.

Here, the seagrass bed was very small compared to the 18 km^2 of the seagrass bed at Ko Muk, a very big seagrass bed in Thailand; also it was much lower in species richness, with only two species compared to the seven species recorded at Ko Muk (Nakaoka and Supanwanid, 2000). However, there was still quite a variety of marine organisms within this seagrass bed; and there was much greater abundance of fauna than on the adjacent bare sediments (personal observation). This might, therefore, be a result of their productivity and the complexity of the seagrasses, which provide both food sources and shelter for the faunas (Heck and Thoman, 1981; Robertson, 1984, Nelson and Bonsdroff, 1990; Irlandi *et al*., 1995; Boström and Mattila, 1999).

Unlike *C. rotundata, T. hemprichii* covered a wide range on the shore, from the sheltered shore to the very exposed shore, where there was high disturbance from sediment movement. However, the highest abundance was found on the moderately exposed shore during the dry season, at the high shore level. This might be a result of reduced disturbance from the sediment movement that caused high water turbidity and stresses to the seagrass. Shading due to high turbidity can cause decreased primary productivity of seagrass. Moreover, sediment movement influenced distribution, abundance and productivity of seagrasses (e.g. Duarte *et al*., 1997; Vermaat *et al*., 1997; Terrados *et al*., 1998) and other marine organisms (see

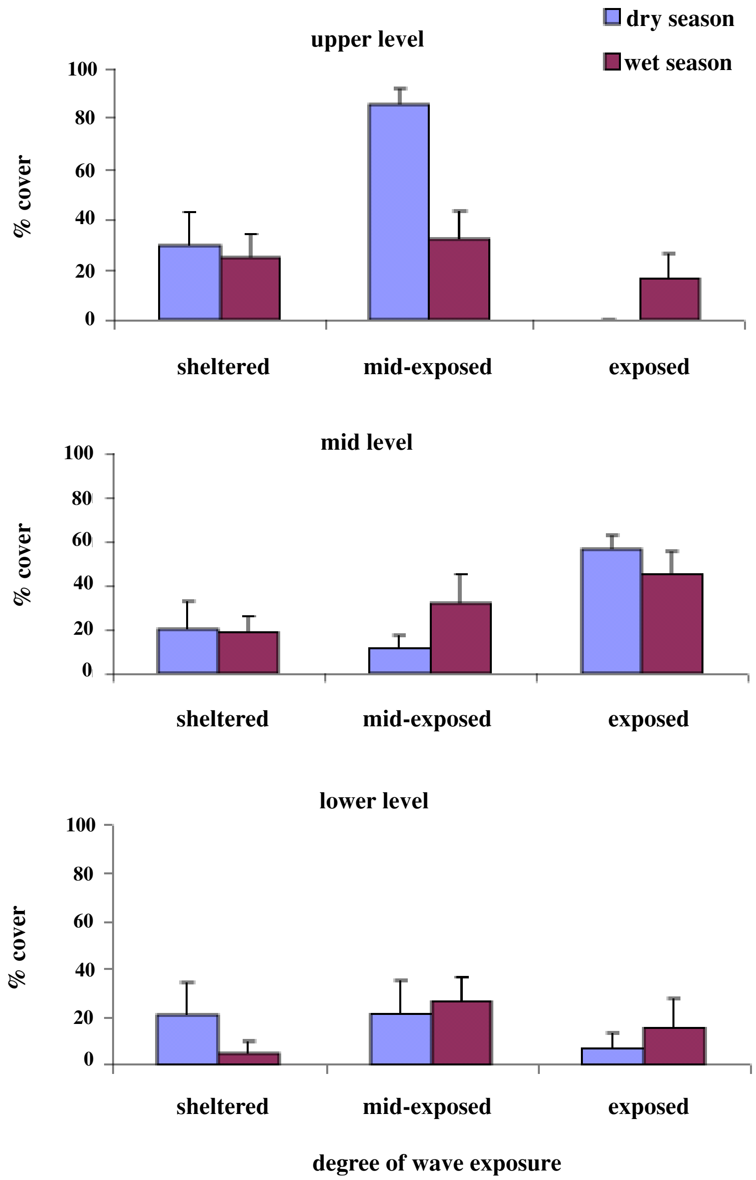

Figure 1. Effects of degrees of wave exposure and levels in two seasons on percentage cover of *Talassia hemprichii*, at Srinart National Park, Phuket.

Prathep *et al*., 2003).

The establishment of a new bed at the sheltered area, where it was protected from the wave exposure, indicated a favorable habitat for the *C*. *rotundata*. However, it is unlikely to overgrow *T. hemprichii* due to the competitive superiority of *T. hemprichii* (Brouns, 1987, Vermaat *et al*., 1995).

Two main processes are responsible for apparent seagrass loss: 1) A natural shift of the bed as part of a natural dynamic trend, producing a loss of seagrasses in one particular area yet an increase in another. A dynamic trend "loss" may appear as a net loss in one area and net gain in another but, in fact, is merely a shift of the seagrass bed resulting in no net loss or gain. 2) Loss

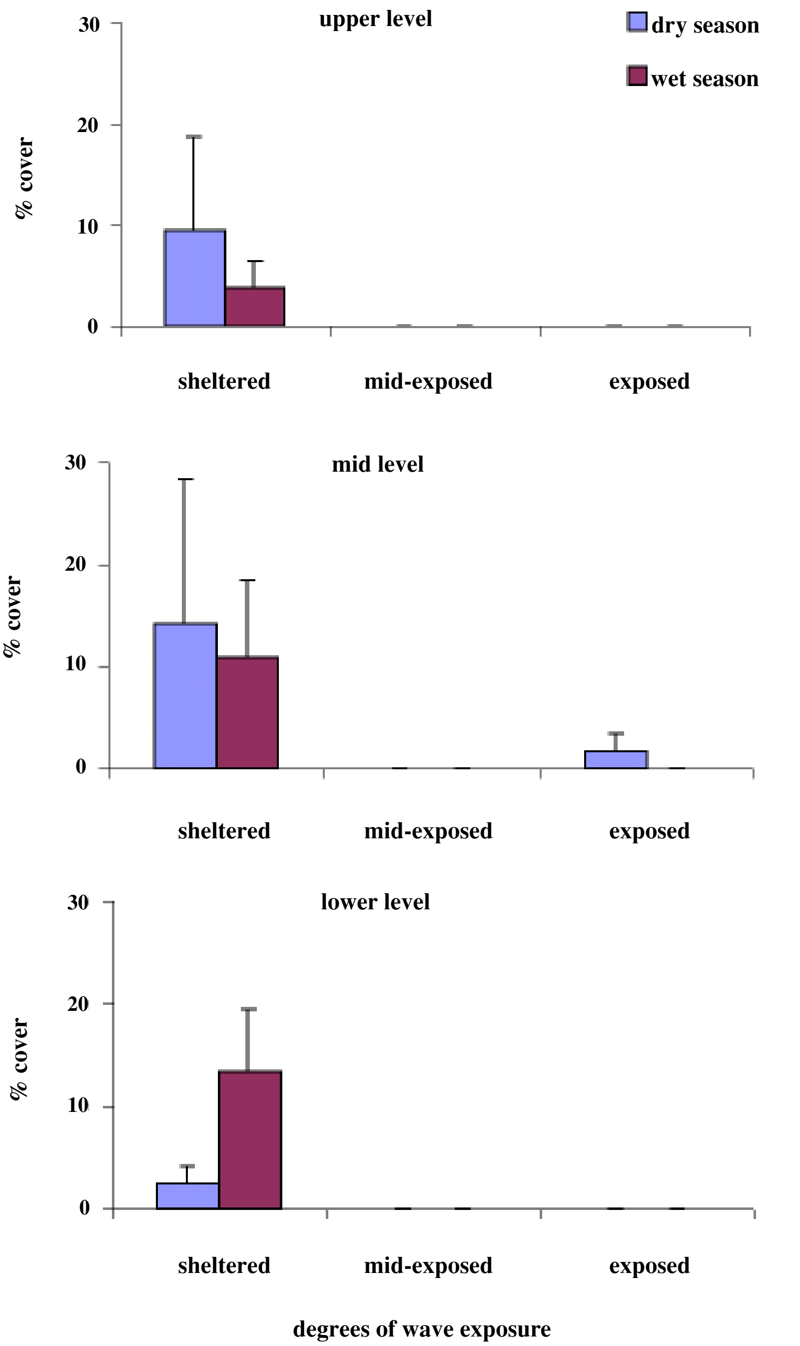

Figure 2. Effects of degrees of wave exposure and levels in two seasons on percentage cover of *Cymodocea rotundata* at Sirinart National Park, Phuket.

due to the weather and human disturbances resulting in a net loss of seagrass. This category includes both natural and anthropogenic causes (Florida Department of Environmental Protection, 2001).

Humans have the potential to greatly disrupt the seagrass ecosystem. Generally, this ecosystem is adapted to cyclic natural phenomena such as changes in temperature, light, and nutrients. In contrast, human activities may be continuous or episodic events, to which organisms are not adapted, e.g. trawling, dredging, and nutrient inputs (Texas and Wildlife, 1999). I have also seen many local people fishing and collecting clams nearby the bed. They might directly disturb the seagrass bed by tramping on the grass or indirectly collect other marine organisms which caused decrease in diversity and an imbalance in the seagrass ecosystem. Unlike the coral reef ecosystem, seagrass and rocky shore ecosystems seem to have less appeal for others even though they are very important primary producers and shelters on coastal areas. Therefore, further research and education on the importance of seagrasses for local people on the seagrass beds and the rocky shore are much needed.

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