Phuket mar. biol. Cent. Res. Bull. **59**: 43-52 (1994)

THE DISTRIBUTION AND SPECIES COMPOSITION OF SEAGRASS BEDS ALONG THE ANDAMAN SEA COAST OF THAILAND

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ABSTRACT

Seagrass beds in Thai coastal waters of the Andaman sea were surveyed from 1988 to 1992. Aerial photographs (scale 1:15,000) were used for identification of potential sites for ground surveys. Salinity, water transparency, depth profile, and sediment composition were analysed. A total of 10 species ofseagrass were recorded at 25 study sites. Three types of seagrass beds were classified: 1) mangrove-associated beds, 2) beds on broad, shallow sand bottoms, and 3) beds associated with coral reefs. Seagrass beds on shallow sandy bottom were the most common. Effects of man-made perturbations such as push-net fishing and siltation are believed to be responsible for degradation of seagrass beds in many areas under investigation.

INTRODUCTION

The natural resources along the coast of Thailand, the Andaman Sea, are abundant and varied. Dominant coastal ecosystems are mangroves, coral reefs and seagrass beds. (Chansang, 1984; Chansang *et al.*, 1981; Chansang *et al.*, 1986; Phongsuwan, 1991). Seagrass beds have a high productivity and serve as a feeding area for many animals, some of which are also food for humans. There have been only five studies on seagrass communities in Thai waters (Poovachiranon, 1988; Chansang *et al.*, 1989; Nateekarnjanalarp and Sudara, 1992; Sudara *et al.*, 1989; Lewmanomont *et al.*, 1991; Aryuthaka *et al.*, 1992). Poovachiranon (op.cit.) provided basic information on five seagrass beds in Phangnga Bay. However, the baseline information needed on distribution and composition of these seagrass communities is still inadequate for management purpose. Rapid economic development of the region has resulted in destruction and degradation of coastal habitats. Therefore, information on coastal resources is urgently needed in order to assess the impact of coastal development on these ecosystems.

The present study was initiated as part of the ASEAN-Australia Economic Co-operative Programme, the Marine Science Project: Living Resources in Coastal Areas. Distribution and species composition of seagrass in 1988-1992 are described together with environmental parameters influencing the seagrass species. This is the first report in a series of investigations. Future reports will present information on community structure, biomass of seagrasses, and community composition.

MATERIALS AND METHODS

Study area

The west coast of Thailand extends approximately 740 km. The shoreline is characterized by mangroves, river mouths, and sandy beaches. Fringing reefs are commonly present around islands or rocky outcrops.

The climate is under monsoonal influence. There are two seasons, *viz.*, a rainy season predominated by the SW Monsoon (May-October) and a dry season predominated by the NE Monsoon (November-April). The tide is semidiurnal with a range of 1.1 to 3.2 m. Tide was measured at mean low water (MLW) and mean high water (MHW) at various stations along the Andaman Sea coast from 1988-1992. Mean sea level is about 2.2 m (calculated from Tide Table of the Hydrographic Department, Royal Thai Navy).

Aerial photographs (scale 1:15,000) were used to identify potential sites. Next, a visual survey was conducted to map the extent of grass beds and decide whether to conduct further study by the line transect method (Dartnall and Jones, 1986). When the area with seagrass was small, and the density low, only general information on species and extent of the beds were noted. Line transects were conducted in well developed grass beds perpendicular

to the shoreline. Four quadrats (50 x 50 cm) were sampled at 50 m intervals. Seagrass was identified to species, and the percentage cover estimated visually at the sites. Transect depth profile was measured at maximum high tide at 50 m intervals. Small buoys (placed on the transect during low tide) marked the intervals. Water trans-parency was measured during high tide (secchi-disk). Sediments were core-sampled to a depth of 10 cm, then sieved (wet) to determine median grain size and % silt. The fractions were oven-dried, weighed, combusted at 550°C for 2 hrs, and organic matter calculated.

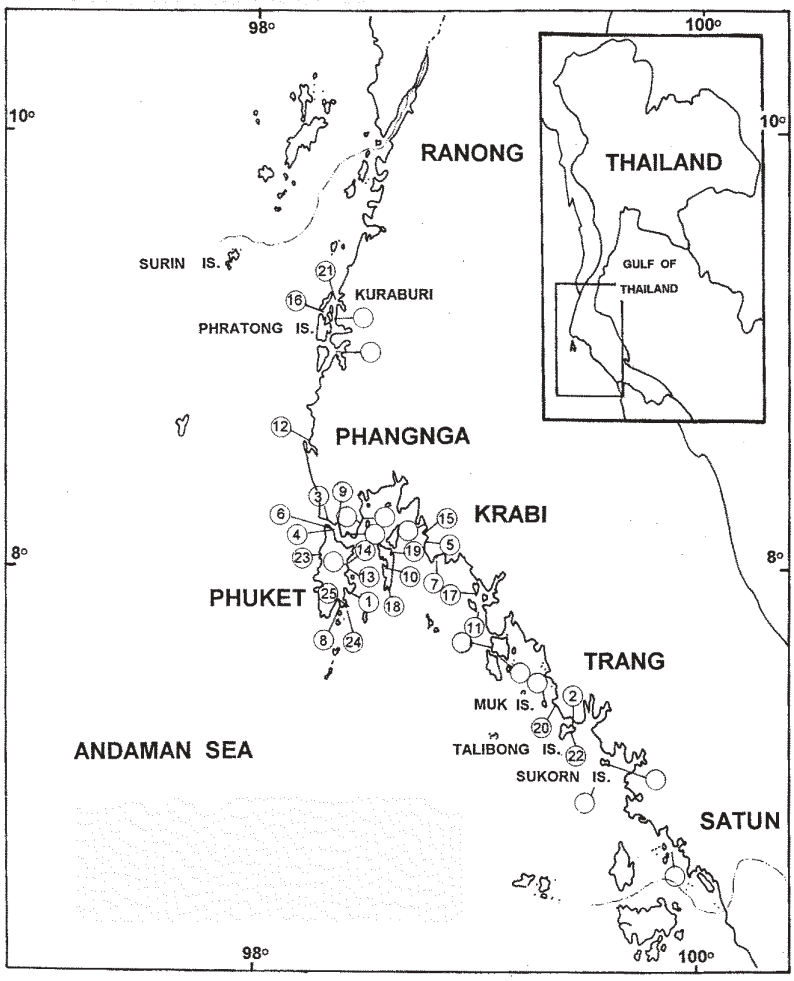

Figure 1. Distribution of seagrass beds along the Andaman coast of Thailand. Circle with number indicates aseagrass bed studied with line transect; a circle without number indicates qualitative study.

RESULTS

Seagrass bed distribution

We estimate that seagrass beds along the Andaman Sea coast of Thailand cover more than 30 km². Within this area, a total of 38 grass beds were sampled from Ranong (north) to Satun (south), but only 25 of those were studied in details. The excluded sites had very patchy beds with low grass cover (<10%). Thus it was not possible to apply the transect line method used in this study. Two of those sites were in Kuraburi; 5 sites in Phangnga Bay; 2 sites at Lanta Island, Krabi province; 3 sites at Muk and Sukorn Islands, Trang province; and one site at Khaoyai Island, Satun province.

Fig. 1 shows the distribution of the seagrass beds. Most beds were located in enclosed or semi-enclosed embayments from the intertidal to 5 m depth. Grass beds were found on both sides of the large Phangnga Bay spanning the east coast of Phuket to the west coast of Krabi. However, no grass beds were found at the inner part of Phangnga Bay or estuaries of Kra river on the west coast of Ranong province. Seagrass beds were also absent in other major estuaries associated with extensive mangroves characterized by turbid water, soft mud substratum and fluctuating salinity. Table 1 summarizes location, type of grass bed, substratum, distance from shoreline, estimated area of grass bed, maximum depth at deep edge, water transparency, and estimated % grass cover.

Table 1. Site description of seagrass beds. Type of grass bed (I = mangrove-associated grass bed, II = seagrass bed on shallow sandy bottom, and III = seagrass bed associated with coral reef). ST = silt, VFS = very fine sand, FS = fine sand, MS = medium sand, CS = coarse sand, VCS = very coarse sand.

	Location	Longitude	Latitude	Grass bed Type	Substrate	Transect distance from shore (m)	Area (Km^2)	Maximum depth (m)	Transparency (m)	Average Grass cover (%)
1	Banlaemphappha	98°25'E	7°52'N	I	VFS	250	0.087	2.8	0.56	50.0
2	Talibong-1 Island	99°26'E	7°15'N	I	FS-VFS	250	1.000	3.7	3.20	62.0
3	Banthayai	98°12'E	8°18'N	I	MS	260	0.900	4.7	2.90	56.0
4	Banpakklongyid	98°12'E	8°18'N	I	MS-CS	270	0.225	4.8	2.50	40.0
5	Ao-Thalane	98°45'E	8°08'N	I	FS	350	0.708	2.8	3.00	80.0
6	Thachatchai	98°12'E	8°18'N	I	FS-MS	350	0.112	2.8	1.97	40.0
7	Ao-Nang	98°46'E	8°02'N	I	FS	400	0.900	2.5	1.50	75.0
8	Ao-Chalong	98°22'E	7°50'N	I	FS-VFS-ST	470	0.060	2.1	1.02	20.0
9	Ao-Tonong	98°12'E	8°19'N	I	CS-MS-FS	550	0.607	3.3	2.90	40.0
10	Yaoyai-1 Island	98°35'E	7°59'N	I	FS-VFS-ST	640	0.433	3.0	2.00	76.0
11	Cham Island	99°00'E	7°48'N	II	VFS-FS	650	0.585	3.5	2.90	85.0
12	Banthublamu	99°14'E	8°35'N	II	FS	700	0.700	3.9	3.00	75.0
13	Banpaklok-2	99°25'E	8°01'N	II	FS-MS	700	2.000	5.0	2.00	60.0
14	Banpaklok-1	99°25'E	8°02'N	II	VFS-FS	750	1.750	4.4	2.25	70.0
15	Banthalane	98°44'E	8°08'N	II	FS	800	0.472	3.5	2.90	73.0
16	Phratong-Island	99°17'E	9°17'N	II	MS-FS	850	2.000	4.9	3.20	75.0
17	Sriboya Island	98°59'E	7°51'N	II	VFS	900	1.500	3.2	2.90	76.0
18	Yaoyai-2 Island	98°36'E	7°55'N	II	FS	1000	1.012	3.2	5.00	50.0
19	Yaoyai-3 Island	98°37'E	8°04'N	II	FS-VFS	1000	1.687	3.6	1.00	57.0
20	Haad-Chaomai	99°21'E	7°23'N	II	VFS	1100	6.360	3.8	3.80	54.0
21	Kurabury	98°20'E	9°14'N	II	VFS-MS	1300	1.280	5.4	4.00	56.°
22	Talibong-2 Island	99°26'E	7°13'N	II	VFS	1900	6.000	3.0	3.20	73.0
23	Naiyang	98°17'E	8°05'N	III	VCS	140	0.070	2.5	4.50	42.0
24	Ao-Tungkhen	98°25'E	7°49'N	III	VFS-FS	140	0.077	2.3	3.50	30.0
25	Taphaoyai Island	98°22'E	7°50'N	III	MS-CS-VCS	350	0.175	5.1	1.35	20.0

Salinity varied from 30 to 32 ppt at all sites, except at some mangrove-associated beds, where salinity could drop to 26-30 ppt during the rainy season (Poovachiranon and Satapoomin, 1994).

Most grass beds were located in rather turbid environment with a transparency of about 5 m, usually 1-3 m. Thus the maximum depth of seagrasses was limited to 5.4 m (MHW). They grew on a wide range of substrata from mud to very coarse sand, although most beds occurred in fine to very fine sand. The percent grass cover ranged from 20 to 85%.

The types of seagrass beds

Based on the 25 sites studied in detail, seagrass beds were grouped into 3 types (Fig. 2) using general characteristics of location, coverage, and sediment type:

Type I. Mangrove-associated seagrass beds. These were mostly located in embayments facing mangrove shorelines. Profiles of such grass beds were rather short. Water depth increased rapidly at the steep edge.

Type II. Seagrass beds on shallow sandy bottom. These were located in protected areas among coastal islands, the shoreline, or in semi-enclosed embayments forming large shallow sandy basins.

Type III. Seagrass beds associated with coral reefs. These were located in the littoral zone, at reef flats in shallow water (Fig. 2B), or further down in the forereef zone (Fig. 2A).

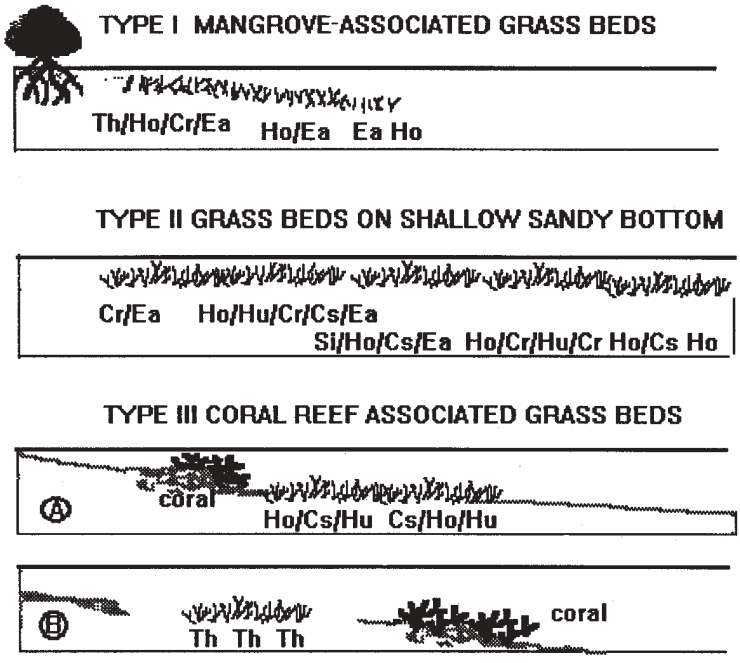

Figure 2. Diagram showing distribution and zonation pattern of 3 types of seagrass beds. Cr = *Cymodocea rotundata*, Cs = *Cymodocea serrulata*, Ea = *Enhalus acoroides*, Ho = *Halophila ovalis*, Hu = *Halodule uninervis*, Si = *Syringodium isoetifolium*, and Th = *Thalassia hemprichii*.

I. Mangrove-associated seagrass beds.

A total of 10 grass beds belong to this category characterised by homogeneous, sandy sediment. However, in some areas the substrata changed regularly along the transect in the offshore direction. *e.g.*, from very fine sand to mud; or from fine sand to coarse sand. Type I beds usually extended as narrow bands along the shoreline (250 m to 640 m wide). The estimated bed areas ranged from 0.06 to 1.0 km^2. Seagrass cover was variable, but generally not dense (mean 54% coverage). a total of 8 species were found in Type I beds (Table 2). *Enhalus acoroides*, *Halophila ovalis* and *Thalassia hemprichii* dominated. Poovachiranon and Chansang (1994) described community structure and biomass.

Table 2. Occurrence of seagrass species according to site and community type I-III. Hd = *Halophila decipiens*, Hb = *Halophila beccarii*, Hp = *Halodule pinifolia*, Si = *Syringodium isoetifolium*, Hu = *Halodule uninervis*, Cs = *Cymodocea serrulata*, Cr = *Cymodocea rotundata*, Th = *Thalassia hemprichii*, Ea = *Enhalus acoroides*, and Ho = *Halophila ovalis*.

SITE	TYPE	SPECIES										NO. OF SPECIES
		Hd	Hb	Hp	Si	Hu	Cs	Cr	Th	Ea	Ho	
1. Banlaemphappha	I	-	-	-	-	-	-	-	-	X	-	1
2. Talibong-1 Island	I	-	-	-	-	-	-	-	-	X	X	2
3. Banthayai	I	-	-	-	-	-	-	X	X	X	X	4
4. Banpakklongyid	I	-	-	-	-	-	-	X	X	X	X	4
5. Ao-Thalane	I	-	-	-	-	-	-	-	-	-	X	1
6. Thachatchai	I	-	-	-	-	-	-	-	X	X	X	3
7. Ao-Nang	I	-	-	X	-	-	-	X	X	-	X	4
8. Cham Island	I	-	-	-	X	X	X	X	X	X	X	7
9. Ao-Chalong	I	-	-	-	-	-	-	-	-	X	-	1
10. Ao-Tonong	I	-	-	-	-	-	-	-	X	X	X	3
11. Yaoyai-1 Island	II	-	(X)	-	-	X	-	-	X	X	X	5
12. Banthublamu	II	(X)	-	X	X	X	X	-	-	X	X	7
13. Banpaklok-2	II	-	(X)	-	-	-	X	X	X	X	X	6
14. Banpaklok-1	II	-	-	-	-	X	X	X	X	X	X	6
15. Banthalane	II	-	-	X	-	-	X	-	X	X	X	5
16. Ko Phratong	II	-	(X)	-	(X)	X	-	-	-	X	X	5
17. Sriboya Island	II	-	-	-	-	X	X	X	-	X	X	5
18. Yaoyai-2 Island	II	-	-	X	-	-	-	X	X	X	X	5
19. Yaoyai-3 Island	II	-	-	-	-	-	X	X	X	-	X	4
20. Haad-Chaomai	II	-	-	X	X	-	X	X	X	X	X	7
21. Kurabury	II	-	-	-	X	X	X	X	-	X	X	6
22. Talibong-2 Island	II	-	-	X	X	X	X	X	X	X	X	8
23. Naiyang	III	-	-	-	-	-	-	-	X	-	-	1
24. Ao-Tungkhen	III	-	-	-	-	-	-	X	-	-	X	2
25. Taphaoyai Island	III	-	-	-	-	X	X	-	-	-	X	3
Occurrence		1	3	6	6	9	11	13	15	19	22	
% Occurrence		4	12	24	24	36	44	52	60	76	88	

II. Seagrass beds on shallow sandy bottom.

A total of 12 grass beds belong to this category occurring over large areas of the intertidal. Individual bed sizes ranged from 0.4 to 6.36 km^2. Grass cover was quite high (67% on an average). The two largest beds of this type cover 6.00 and 6.36 km^2. They are located in the Andaman Sea at Talibong-2 Island and Haad Chaomai. *Enhalus acoroides*, *Halophila ovalis*, and *Cymodocea rotundata*. were dominant among 10 species found in Type II grass beds. Substrata varied from very fine to medium sand along the transects.

III. Seagrass beds associated with coral reefs.

A total of 3 grass beds belong to this category. Seagrass was encountered in an intertidal reef flat pool at Naiyang (station 23); on the reef flat at Ao-Tungkhen (station 24); and on the forereef at Taphaoyai Island (station 25). Individual bed sizes ranged from 0.08 to 0.7 km^2. Grass coverage was usually low (20-42%). Type III beds were uncom-

mon in the study area. A total of 5 species were found: *Halophila ovalis*, *Cymodocea rotundata*, *C. serrulata*, *Halodule uninervis*, and *Thalassia hemprichii*. Substrata varied among sites from very coarse sand on a relatively exposed reef flat (station 23), to a mixture of substrata on a forereef in a protected bay (station 25).

Distribution of individual species

The individual species distribution patterns show little segregation along the transects. Each of the species encountered in this study is presented in order of decreasing overall frequency (Table 2). These seagrass species possess high tolerance to environmental conditions, particularly depth, and sediment characteristics (content of organic matter and concentration of silt).

Sediment analysis

Sediment mean grain size and organic content differed considerably among the 3 types of seagrass beds (Table 3). However, the variation was so large that conclusions can only be made in qualitative terms. Seagrass beds of Type I and Type II occurred on fine-grained sediments with low organic content as compared to Type III (Table 3).

Table 3. Water depth and sediment characteristics of the 3 types of seagrass beds.

Characteristic	Type of seagrass beds		
	I	II	III
	Mean (min-max..)		
Depth (m)	2.5 (1.3-5.1)	2.7 (1.3-5.4)	2.4 (2.1-2.9)
Grain size (mm)	0.25 (0.06-0.83)	0.17 (0.09-0.4)	0.40 (0.06-1.55)
% Silt content	4.7 (0.17-19.20)	4.0 (0.27-15.95)	4.4 (1.57-6.45)
% Organic content	2.3 (0.62-6.13)	1.6 (0.39-5.12)	2.4 (1.01-4.65)
Number of samples	139	137	23

Seagrass species in the Andaman Sea

Table 2 shows that *Halophila ovalis*, *Enhalus acoroides* and *Thalassia hemprichii* were the most common species (in that order) while *Halophila decipiens* and *Halophila beccarii* were the most rare species. Individual species and their habitats were encountered as follows:

Cymodocea rotundata Ehrenb. and Hempr. ex Aschers.: common in shallow water on very fine to medium sand in sheltered coves and bays (depth 1.4-3.8 m). It grew in sediment ranging from mud to very coarse sand with 0.4-4.4% organic matter and 0.4-8.1% silt. *C. rotundata* occurred in 13 grass beds. It was particularly common from Phangnga Bay to Trang province.

Cymodocea serrulata (R.Br.) Aschers. and Magnus: common in sheltered localities from the intertidal to the sublittoral at 1.3-5.1 m depth. It grew in fine sand with a high amount of organic matter (0.5-5.1%) and silt (0.2-17.6%), respectively but also in medium sand with broken shells. *C. serrulata* occurred in 11 seagrass beds. It was widespread from the west coast of Phangnga province to Talibong Island in Trang province.

Enhalus acoroides (L.f.) Royle: common in sheltered areas (depth 1.3-5.0 m). Habitats ranged from mud to coarse sand. The species was commonly found next to mangroves. Pure stands occurred in sediments with high amounts of organic matter (0.6-6.1%) and silt (1.1-19.2%). *E. acoroides* occurred at 19 sites.

Halophila beccarii Aschers.: rare in sheltered localities of the upper intertidal at about 1.0 m depth, particularly on mud flats next to mangrove edges. The plants were usually found under a thin, covering layer of silt-clay, indicating that this species tolerates periodic desiccation during low tide. The plants seem to favour sand-mud, in particular muddy substratum, and tend to have a very patchy bottom coverage (den Hartog, 1971). The sediments contained 1.0% organic matter and 7.1% silt. The distribution of *H. beccarii* was limited to small areas at Yaoyai Island, Phrathong Island and Banpaklok-2; furthermore, to restricted areas with high sedimentation rates, such as in the inner part of Phangnga Bay where other species could not be found.

Halophila decipiens Ostenfeld: very rare and not found during field surveys. Some specimens were accidentally collected by a small beam trawler operating in Banthublamu seagrass beds. Details of the habitat are not available.

Halophila ovalis (R.Br.) Hook.f.: the most common species in exposed as well as sheltered habitats of the intertidal and subtidal zones (depth

1.0-5.4 m). Pure stands of *H. ovalis* were found either in sand-mud with broken shells, or in very fine to fine sand habitats. But the species grew in a wide variety of sediments, including mud and coral rubble. It occurred beyond the end of *Enhalus acoroides* communities, where the subtidal substratum was muddy. Organic content and silt ranged from 0.4-5.1%, and from 0.2-17.6%, respectively. *H. ovalis* occurred at 22 sites.

Halodule pinifolia (MiKi) den Hartog: occurred in sheltered bays (depth 1.6-3.8 m). Pure stands occurred in very fine to fine sand with low percentages of organic matter (0.4-2.7%) and silt (0.4-5.4%). It was encountered at 6 sites.

Halodule uninervis (Forsk.) Aschers: occurred in sheltered areas of the intertidal and subtidal zones (depth 1.3-4.9 m). Substrata were sand-mud, fine sand, medium to coarse sand, or very coarse sand. Percentages of organic matter and silt varied considerably (0.4-5.1%) and (0.2-8.0%), respectively. *H. uninervis* was present in 9 seagrass beds.

Syringodium isoetifolium (Aschers.) Dandy: occurred in semi-exposed habitats (depth 1.8-3.3 m). It grew in very fine to fine sand with low percentages of organic matter (0.9-5.1%) and silt (2.0-8.0%). *S. isoetifolium* grew in patches at Cham Island, Krabi, and Phrathong Island, Phangnga. Elsewhere it formed thick carpets in the upper subtidal together with *E. acoroides*, *T. hemprichii*, *C. rotundata*, *H. ovalis*, *C. serrulata* and *H. uninervis*.

Thalassia hemprichii (Ehrenb.) Aschers.: very common in fine/medium/coarse sand in sheltered habitats, or semi-exposed localities (depth 1.4-4.7 m). Organic matter of sediments ranged from 0.4-3.7%, and silt from 0.3-14%. The plants occurred in high density over small areas. Pure stands grew towards the reef margin, occasionally in patches. This species was found at 15 localities.

DISCUSSION

Species diversity and distribution of seagrass

In this study, Type II- grass beds had the highest species diversity (10 species). Type I-beds off mangroves had 7 species, while Type III-beds at coral reefs had 5 species. We speculate that high diversity may be due to a larger area and more suitable environment of Type II-beds in shallow basins.

Among 25 sites examined, 7 sites had more than 5 seagrass species. The greatest species diversity occurred at station 22 with 8 species. Seven species were found along transects at stations 8, 12 and 20. Six species occurred at stations 13, 14 and 21. Most of these beds compri-sed the species *H. ovalis*, *E. acoroides*, and *T. hemprichii*. Four seagrass beds were mono-specific.

Patchy grass beds were often observed (Fig. 1). The species *C. serrulata* was sparsely found in deeper waters, apparently restricted by water transparency and the erosive effect of strong currents. Seagrass associated with coral reefs on some off-shore Islands, *e.g.*, Surin Islands (Christensen and Andersen, 1977) will be investigated in the future.

Plants of genus *Halophila* are the most common marine seagrasses in the Indo-Pacific. In accordance, *H. ovalis* was found at most sites examined. *E. acoroides* was common over a wide range of depths in the Andaman Sea. In contrast, *E. acoroides* was the least common species in northern Australia together with *C. rotundata* (Lee Long *et at.*, 1993). It was also found that *T. hemprichii*, *C. rotundata* and *E. acoroides* were lacking from Australian intertidal zones. In the Andaman Sea, they were quite common in intertidal seagrass communities.

The 10 species of seagrass of this study have also been found in the Gulf of Thailand (Lewmanomont *et al.*, 1991; Nateekarnchanalarp and Sudara, 1992). Altogether, 12 seagrass species have been recorded in Thai waters.

Among the ASEAN countries, the most diverse assemblage of seagrasses was found in the Philippines (Fortes, 1988). Overall, 16 seagrass taxa were reported from the ASEAN region (Fortes, 1992).

Distribution of seagrass

Most seagrasses were found in relatively shallow water (<10 m) in north-eastern Australia, although seagrass could grow to 30 m depth (Coles *et al.*, 1989; Lee Long *et al.*, 1993). Compared to Australia, the seagrass beds in the Andaman Sea

were only found in shallow water at depths <6 m (mean high tide). Turbidity may be the limiting factor, because it was found that secchi depth was similar to the maximum depth of seagrass species. Fluctuating salinity might be another limiting factor in estuaries, such as the inner part of Phangnga Bay. *Halophila ovalis*, *Cymodocea rotundata*, *C. serrulata*, *Halodule uninervis* and *Thalassia hemprichii* were found in reef associated beds in this study. The same species occurred at the Great Barrier Reef. But the species were also present in subtidal areas around Green Island near Cairns, and around Lizard Island (Coles *et al.*, 1987; Coles *et al.*, 1989).

Man made impact on seagrass beds

There has been concern over destruction of grass beds due to human activities. Two major causes have been identified, *viz.* tin dredging near shore and sedimentation from land-based mining. Sedimentation hampers growth of seagrass and feeding possibilities of dugong. Centres for tin mining (both inland and offshore) were Phuket, Phangnga and Ranong provinces. The first offshore tin mining took place in Phuket Bay in 1917. Tailings from mining on land were released downstream into natural water ways. Part of Phuket town was built on land reclaimed after such mining activities. Although Phuket Bay contains much soft sediment which can become resuspended, it is difficult to evaluate the impact on seagrass beds of the present study. There are no previous records of grass bed conditions. We speculate that seagrass formerly was abundant in the small embayments along the coast of Phuket. At present, some patches of *Enhalus acoroides* grow near the mean low tide level. Suitable habitats are also found on the north-east coast. Yet, sedimentation is a relevant and chronic problem for grass beds of Phuket and Phangnga provinces. Mining activities have decreased drastically in most areas in recent years, but it remains to be shown to what extent seagrass is influenced by the new situation. Land development resulting in land fill, open top soil on roads, and construction of buildings on hill slopes seem to have replaced the land mining activities as sources of fine particles which ultimately deposit in coastal waters.

Destruction of beds can also be caused by larger beach nets, mechanised push nets, and trawlers on grass beds. Evidence of damage has been in the form of fragmented grass washed ashore at Haad Chaomai (station 20 near station 22). However, the actual damage was difficult to estimate. Information from local villagers or actual measurements are needed. We believe that destruction by fishing activities is most pronounced in Krabi and Trang provinces, and to smaller extent along the north east coast of Phuket. The effort by local villagers to discourage push net operations on grass beds, and prevention of trawlers near shore, seem to yield better growth of seagrasses as well as improving catches of small scale fishermen.

ACKNOWLEDGEMENTS

This research was funded by ASEAN-Australia Economic Co-operative Programme in Marine Science Project II: Living Resources in Coastal Area. We are grateful for field and laboratory assistance provided by staff of Phuket Marine Biological Center. We appreciate useful comments by Dr. Mark S. Fonseca, Dr. D.W. Klump and Dr. D.M. Dexter on the draft manuscript. Prof. Jorgen Hylleberg is thanked for editing the final manuscript. This research was presented at the Third ASEAN Science and Technology Week Conference. An abstract was printed in the Proceedings of this conference (Marine Science: Living Coastal Resources, 21-23 September 1992, Singapore).

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