Sediment Deposition In A South Sulawesi Seagrass Bed

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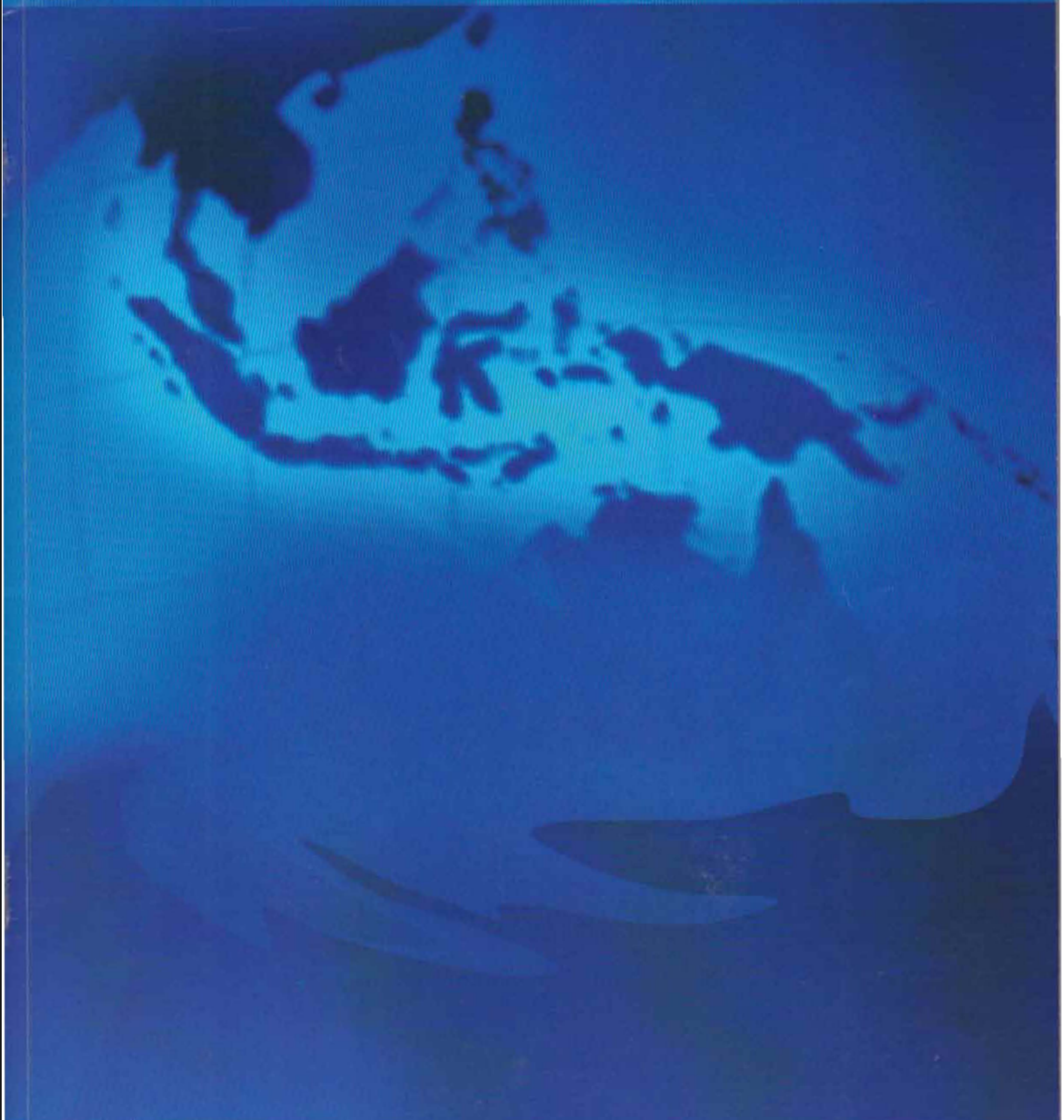

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SEDIMENT DEPOSITION IN A SOUTH SULAWESI SEAGRASS BED

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ABSTRACT

Deposition of suspended sediment was measured with sediment traps in shallow coastal waters colonized by *Thallasia* dominated seagrass in Pannikiang Island, South Sulawesi (Indonesia). The primary objective of this study was to compare the amounts of sediment deposition inside seagrass beds and in adjacent unvegetated area. The traps were placed in a seagrass bed (Station I, II, and III) and in an adjacent unvegetated area (Station IV) measuring the sediment flux on the seabed. The sediment fluxes due to deposition were significantly higher at stations I and II ($P < 0.05$) and station III ($P < 0.01$) than at station IV (unvegetated area). Results of this study suggest that sediment deposition was promoted by dense shoots of seagrass. The study provides quantitative evidence for the importance of seagrass bed as sites of sedimentation of fine particles.

Keywords: Sediment, deposition, sediment trap, seagrass, South Sulawesi, Indonesia

INTRODUCTION

Seagrass beds are higly productive and dynamic ecosystems. They are found in coastal area that are subjected to varied tidal fluctuations, influx of freshwater and eutrophication. Beds provide an important habitat for many marine organisms including juvenile fish and macroinvertebrate species, providing a place for shelter and refuge. They also provide valuable food source for grazing aquatic invertebrates that feed on the epiphytes living on the seagrass (Fairhurst and Graham, 2003).

Seagrass beds are also known to promote deposition of particles (Almasi *et al*., 1987), and loss of seagrass beds is often followed by sediment erosion (Christiansen *et al*., 1981). This effect of seagrass beds on sediment deposition results from the reduction of water flow (Fonseca *et al*., 1982), and the protection of sediments against the resuspension due to energy dissipation by the plant canopies (Ward *et al*., 1984).

The influence of seagrass bed on the process of hydrodynamics and sedimentation has been an interesting topic in recent years. However, there was relatively few research in Indonesia regarding this field. Previous seagrass studies in Indonesia mostly deal with biological and ecological of seagrasses (e.g. Erftermeijer *et al*., 1993; Sterrenburg *et al*., 1995) rather than physical (hydrodynamics) and sediment dynamic in seagrass bed. This paper, thus, evaluates the influence of seagrass on the process of sedimentation. The primary objective of this study was to compare the amounts of sediment deposition inside seagrass beds and in adjacent unvegetated area.

MATERIALS AND METHODS

The field work was conducted in June 2005 at shallow coastal waters colonized by *Thallasia* dominated seagrass in Pannikiang Island, South Sulawesi (Fig.1). Four sampling stations were worked out in the study area consisted of three stations in a seagrass bed and one station in an adjacent unvegetated area. These three seagrass stations were each located at south side (Station I), north side (Station II), and west side (Station III) of the island, while the station of unvegetated area was located at east side of the island (Station IV).

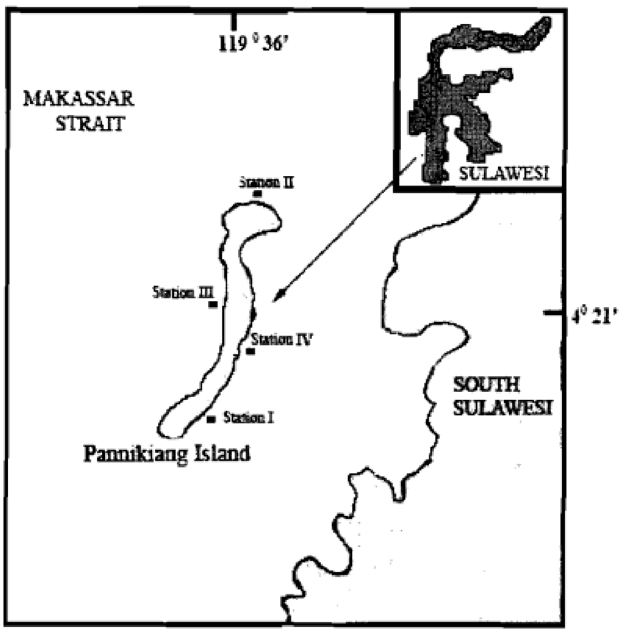

Figure 1. Map of study site.

Three sediment traps were deployed at the sea-bed at each sampling station to measure the amounts of sediment deposition. The traps consist of PVC tubes closed at the lower end. The inner diameter of the tubes is 3.0 cm and the length of the tube is 15.0 cm giving an aspect ratio of 5 which is consider optimal for measuring sediment flux in horizontal flows, in which maximum speed infrequently reach 0.2 m s^{-1} (Gardner, 1980). All traps were mounted on an iron stick of 50 cm long, diameter 0.5 cm, and driven into the sea bottom at each sampling station.

Sediment deposited at the traps was collected after a 3 days deployment period to measure the gross sediment flux, defined as the amount of sediment that comprises both a net sediment flux and a sediment flux induced by resuspension (Lund-Hansen and Eriksen, 1996). The net sediment flux is defined as the amount of sediment that is permanently deposited at a site. Materials collected in the traps were filtered using preweighed Millipore GEM filter of 0.45 µm pore size. The filters were dried for 2 hours at 105 °C and weighed.

At a seagrass bed a quadrant of 1 m^2 metal pipe frame was laid, and the number of seagrass shoots were counted. This quadrant is divided into 16 subdivisions to facilitate calculation. Samplings were done randomly in order to avoid overestimation (Dennison, 1990).

One-way ANOVA was used to test difference in deposition rate between stations. Differences were regarded as statistically significant when the probability of error was lower than 5% ($P < 0.05$). Tukey's multiple comparison test was used to locate any differences identified by ANOVA (Fowler and Cohen, 1997).

RESULTS

The mean deposition rate within the seagrass bed varied from minimum values of 7.3 at station I to maximum values of 16.6 g m^{-2} d^{-1} at station III. The mean deposition rate at Station IV varied from minimum values of 0.9 to maximum value of 5.9 g m^{-2} d^{-1} (Fig. 2). ANOVA analysis revealed that sediment fluxes due to deposition were significantly higher at stations I and II ($P < 0.05$) and station III ($P < 0.01$) than at station IV. However, there were no significant differences in sediment fluxes due to deposition detected between seagrass stations. These results indicated that deposition rates were significantly higher at seagrass bed than those at adjacent unvegetated area.

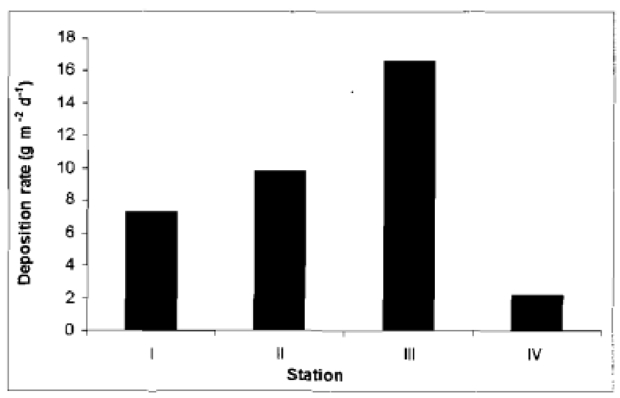

Figure 2. Deposition rate at the seagrass bed (stations I, II, and III) and unvegetated area (station IV).

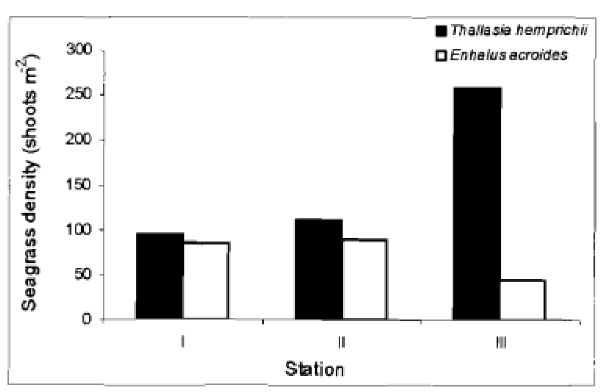

Figure 3. Shoots density of *Thallasia hemprichii* and *Enhalus acroides* at the study site.

The mean shoot density of *Thalassia hemprichii* at the study site varied from minimum value of 96 at Station I to maximum value of 258 shoots m^{-2} at Station III. The density of *Enhalus acoroides* at the study site was lower than *Thalassia hemprichii* which varied from minimum value of 44 at Station III to maximum value of 90 shoots m^{-2} at station II (Fig. 3).

DISCUSSION

The deposition rates recorded for the present study are lower than those reported from around the world (Table 1). The values observed in the South Sulawesi are low when compared to the rates reported for shallow coastal area in The Philippines and Hong Kong, East China Sea (Table 1). This comparison should, however, be considered with caution, since our data only reflect a single short-term sampling duration. Furthermore, as we did not sample under extreme weather conditions that may enhance deposition (e.g. heavy rainfall and typhoons) the range of values reported here should represent the minimum estimates of the average deposition rate in the area.

Deposition rates were significantly higher in the seageass bed than in the adjacent unvegetated area suggesting that deposition of fine particles is promoted by dense shoots of seagrass. These results agree with other studies, e.g. by Almasi *et al*. (1987) who found that sedimentation rates were higher inside seagrass area than unvegetated area.

Higher deposition rates found in the seagrass bed area probably due to the ability of the seagrass to slow down current velocity (Fonseca *et al*., 1982) and due to wave orbital velocity near the bottom (Ward *et al*., 1984) creating a quiescent environment which is favorable for suspended particles to settle out from the water column. In addition, leaves together with epiphytic growth on the leaves of the seagrass can actively trap finer-grained sediments transported over the seagrass by adhering waterborne particles to the leaves.

Efficacy of seagrass in trapping suspended particles depends on several factors such as shoot density, type and size of seagrass. The deposition rate tends to increase with increase of *Thalassia hemprichii* density in this study. As an example, deposition rate was high at Station III where the shoot density of *Thalassia hemprichii* was also high. This result is similar with the results of Ukkas *et al*. (2000) who found that the increase of sedimentation rate was parallel with the increase of density of artificial seagrass shoots. Unlike *Thalassia hemprichii,* the trend of increasing deposition rate with increasing shoot density was not observed for *Enhalus acoroides*. This fact indicates that at the study site *Enhalus acoroides* was less effective in enhancing sediment deposition than *Thalassia hemprichii*.

CONCLUSION

The deposition rates were significantly higher at seagrass bed than those at adjacent unvegetated area suggesting that deposition of fine particles is promoted by dense shoots of seagrass. Higher deposition rates at seagrass bed than those at

Table 1. Range and mean sediment deposition rate for different shallow coastal area.

Locality	Deposition rate ($g\ m^{-2}\ d^{-1}$)		Deployment depth (m)	Area/bottom	Reference
	Range	Mean			
Bay of Calvi, Corsica (Mediterranean)	0.04 – 9.8	2.3	36	*Posidonia oceanica*	Dauby *et al.* (1995)
Chesepeake Bay (N.W. Atlantic)	23 - 115	51.4	< 1	*Rupia maritima*	Ward *et al.* (1984)
Kiel Bight (Baltic sea)	0.1 – 79.9	4.6	18	mud	Smetacek (1980)
Philippines (S. China Sea)	18 - 175	-	< 3	mixed seagrass	Gacia *et al.* (2003)
Hong Kong (S. China Sea)	29 - 145	67.4	1.4	*Zostera japonica*	Lee (1997)
South Sulawesi, Indonesia (Makassar strait)	0.9 – 16.6	8.3	< 1	mixed seagrass	This study

adjacent unvegetated area are probably due to baffling (slowing down current and wave orbital velocity near the bottom) and trapping effects of the seagrass shoots. The present study provides quantitative evidence for the importance of seagrass bed as sites of sedimentation of fine particles.

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