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Seagrass Community Composition and Biomass at Nahpali Island, Pohnpei

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Abstract—The seagrass community off the barrier reef island of Nahpali, Pohnpei State, Federated States of Micronesia, was sampled in August 1996 to determine species composition and above-ground biomass. Three species were found: *Cymodocea rotundata*, *Enhalus acoroides,* and *Thalassia hemprichii*. This is the first time that *C. rotundata* has been recorded for Pohnpei. There were differences in the distribution relative to distance from shore for these seagrass species. *Enhalus acoroides* at this site showed significantly lower mean biomass (4.95 g dry weight/ m^2) than the other two species (*C. rotundata* 42.53 g dry weight/ m^2, *T. hemprichii* 21.86 g dry weight/ m^2).

Introduction

Seagrasses (Division Magnoliophyta) are important primary producers in tropical Indo-Pacific shallow water communities. Extensive seagrass meadows occur along the coast of Pohnpei, Federated States of Micronesia (FSM), but until recently the ecological role of these seagrasses has remained undocumented and unappreciated. However, with the growing concern in Micronesia for the conservation of sea turtles, for the management of coastal fish populations, and for the protection of coral reefs, there is an obvious need for a greater understanding of the role played by seagrasses in grazing and detritus food webs, nutrient recycling, sediment retention, and shoreline stabilization. Turbidity, temperature, currents, salinity, herbivores, and substratum are factors that can influence the growth of seagrasses. One of the best ways to assess the combined influence of these factors is to measure the presence of seagrasses relative to the shoreline, and then hypothesize how these possible physical and biological factors influence the changes in composition of the seagrass meadow.

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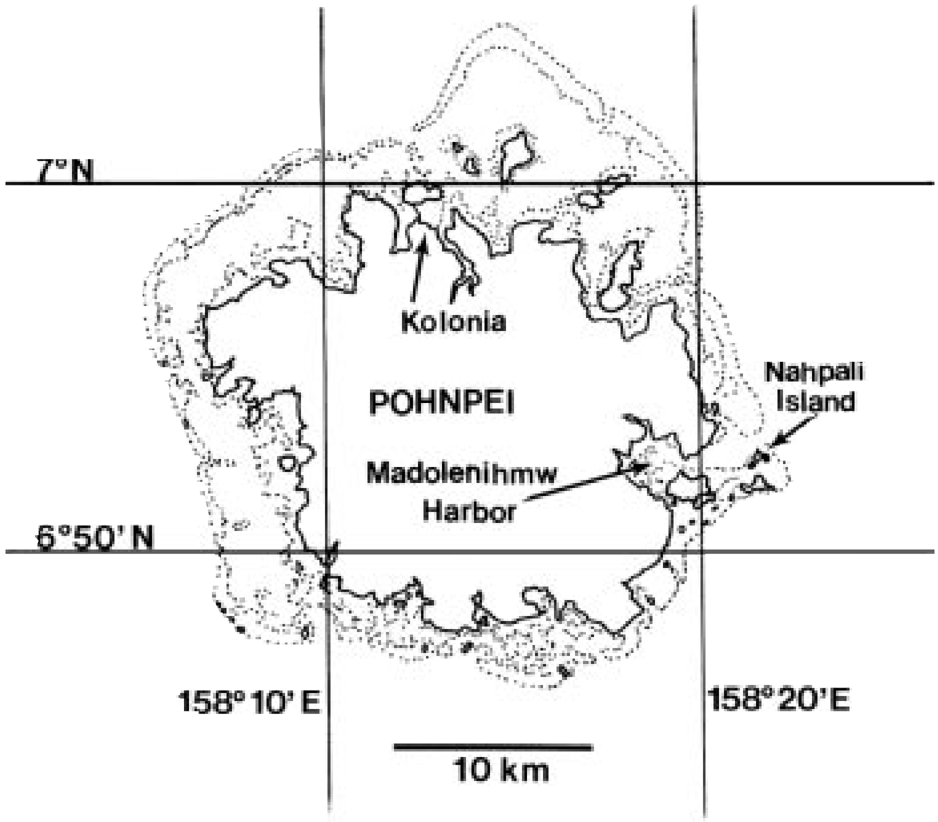

Figure 1. Map of Pohnpei, Federated States of Micronesia. This study was conducted on the northwest reef flat of Nahpali Island.

Ten species of seagrasses are known to exist in Micronesia (Tsuda et al. 1977, McMillan 1980). However, little research has been done on the ecology of seagrass assemblages throughout Micronesia (Palau: Ogden & Ogden 1982, Yap: Kock & Tsuda 1978). Only two species of seagrass, *Enhalus acoroides* (L. *f.*) Royle and *Thalassia hemprichii* (Ehrenb.) Aschers., have been reported from Pohnpei (Tsuda et al. 1977). This study is the first quantitative assessment of a seagrass community in Pohnpei.

Materials and Methods

Research on seagrass abundance and biomass was conducted at Nahpali Island off the southeast coast of Pohnpei from August 10-16, 1996 (Fig. 1). This reef is known to be valuable in terms of marine resources, particularly reef fish, and historically as a sea turtle nesting area (U.S. Army Corps of Engineers 1985). With the assistance of participants in a course called Quantitative Underwater Ecological Survey Techniques, four transect lines 100 m in length were laid out

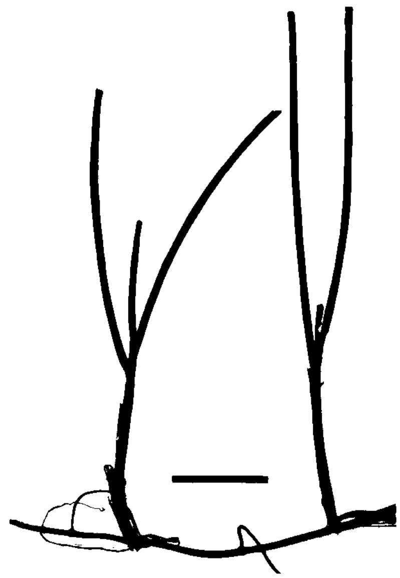

Figure 2. Voucher specimen of *Cymodocea rotundata* Ehrenb. & Hempr. ex Aschers. from Nahpali Island reef flat (KM4187). This species is recognizable because of its thin, ribbon-like leaves, smooth herbaceous rhizomes, and rounded leaf tips. Scale bar = 4.5 cm.

perpendicular to the shoreline on the northwest shore of Nahpali Island. The work was done at low tide, in water depths ranging from 10 cm deep at 5 m from shore to about 40 cm deep at the edge of the seagrass bed on this reef (55–70 m from shore). Salinity was measured as 31 ppt using a refractometer. Presence or absence of seagrass species was assessed with a 1 m^2 quadrat every 5 m in two replicate quadrats taken on each side of the transect line. Species were identified and scored with a categorical response variable: 0 for absent, 1 for sparse, or 2 for abundant. Additionally, at 5 m intervals along the transect lines, biomass samples were taken by using scissors to cut all seagrass leaves and shoots above the substratum within a 400 cm^2 quadrat. The cut plant material was put into labeled plastic bags. Within 6 hours, the leaves and shoots from each quadrat were sorted by species into labeled brown paper bags, and dried slowly in an oven for 24 h. at 60–105°C. Dried samples were weighed to the nearest 0.01 g. Values were converted to dry grams per m^2. These methods are similar to those outlined in Johnstone (1979). Voucher specimens were deposited in the Bernice Pauahi Bishop Museum Herbarium in Honolulu (BISH).

Results

Although Tsuda et al. (1977) reported in a previous study that only two species, *Enhalus acoroides* and *Thalassia hemprichii,* were present on the reef flats in Pohnpei, we found that *Cymodocea rotundata* Ehrenb. & Hempr. ex Aschers. (Fig. 2) is not only present, but also abundant on the reef at Nahpali Island.

Seagrass biomass was high (greater than 50 g dry weight/ m^2) from nearshore to 50 m offshore (Fig. 3). At 55 m from shore and beyond, to the edge of the fringing reef, corals and seaweeds began to dominate the space, and seagrass biomass dropped below 40 g dry weight/ m^2.

Cymodocea rotundata was the most abundant among the three species from 5 m to 40 m offshore. However, farther offshore, its biomass declined below that of *Thalassia hemprichii. Thalassia hemprichii* became the more abundant species at 45–50 m. *Enhalus acoroides* showed the least biomass of the three species, and it was rare on the reef. Although there seem to be differences in the biomass from shore to the edge of the reef (Fig. 4), one way analysis of variance (ANOVA) showed that there is no significant difference in biomass between distance intervals for any of the three species (*C. rotundata* $p = 0.282$, *E. acoroides* $p = 0.79$, *T. hemprichii* $p = 0.615$). However, ordinal logistic regression analysis of the scored relative abundance data using distance as a predictor indicated that greater distance from shore tends to be associated with lower abundance of *C. rotundata* (coeff = 0.086, Z = 6.28, $p < 0.001$, odds ratio > 1.0). In addition, goodness-of-fit tests showed that the model fits the *C. rotundata* data adequately (Pearson $X^2 = 22.73$, $p = 0.593$). Logistic regression analysis of *E. acoroides* suggested an association between distance and relative species abundance ($p = 0.021$), but the goodness-of-fit was poor (Pearson $X^2 = 25.13$, $p = 0.014$). For *T. hemprichii*, logistic regression analysis demonstrated that no significant relationship exists between distance and relative species abundance ($p = 0.903$).

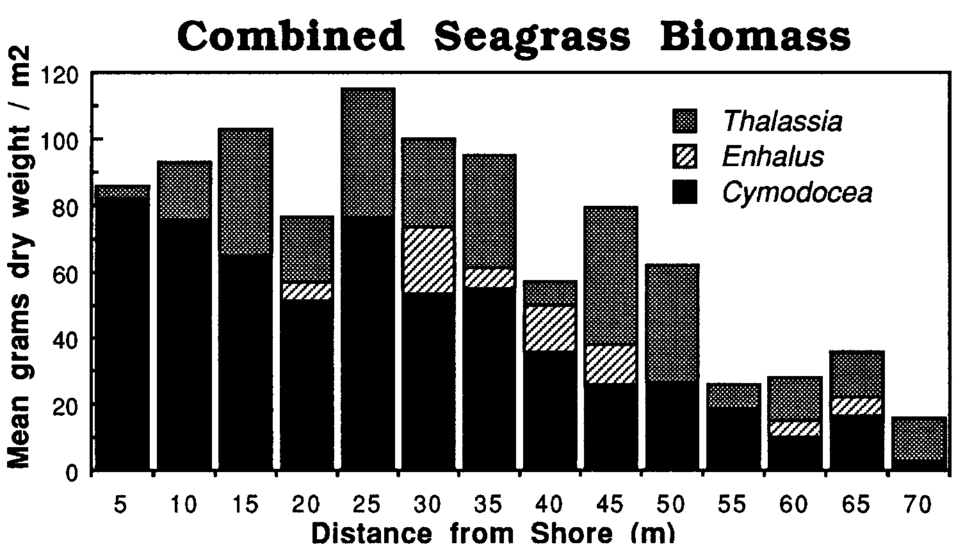

Figure 3. Combined mean biomass of seagrass at 5 m intervals along transects perpendicular to Nahpali Island shoreline.

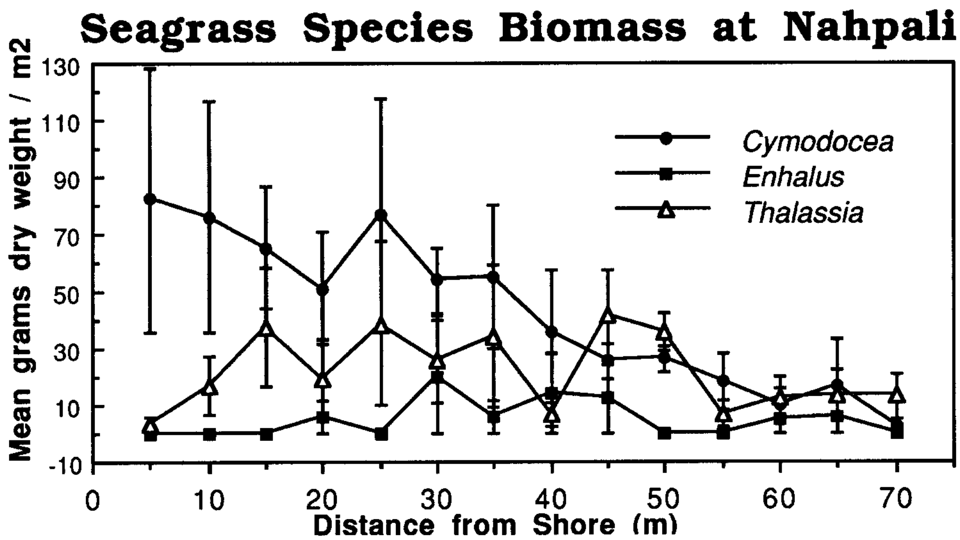

Figure 4. Mean biomass values of the three seagrass species showing standard error (SE) bars for each mean at each 5 m interval.

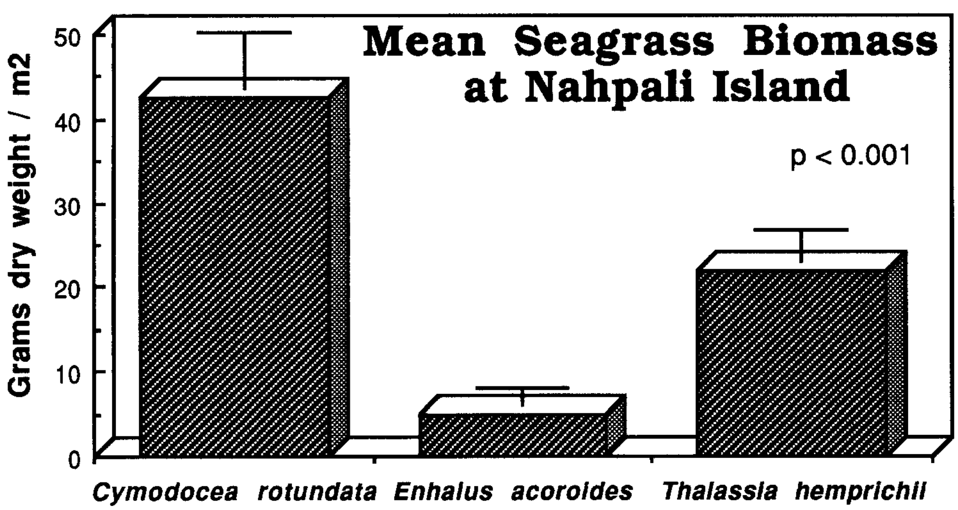

Figure 5. Overall mean biomass for the three seagrass species. Bars represent the standard error of the mean (SE).

On the Nahpali Island reef, *Cymodocea rotundata* had the highest mean dry weight per m^2 (42.53 g/ m^2); whereas, *Enhalus acoroides* had the lowest mean dry weight (4.95 g/ m^2), and *Thalassia hemprichii* had a mean dry weight of 21.86 g/

m^2 (Fig. 5). ANOVA showed that there is a significant difference in above-ground (leaf and shoot) biomass between the species ($p < 0.001$). This is noteworthy because although *C. rotundata* is the smallest species in size, it had a far larger proportion of the overall biomass compared to the other two species.

Discussion

Although no previous published record of *Cymodocea rotundata* from Pohnpei exists, the presence of this species is not unexpected. The distribution of *C. rotundata* had seemed strangely disjunct, with populations reported west to east across the Pacific from Palau, Yap, Woleai Atoll, Ifalik Atoll, Chuuk, and then a jump to Kosrae (Tsuda et al. 1977). Subsequent collections in 1996 and 1997 at other sites on Pohnpei and Ant Atoll have also included *C. rotundata* (McDermid unpublished). We believe that future surveys in the Federated States of Micronesia may extend the ranges of other seagrass species.

This study shows that *Cymodocea rotundata, Enhalus acoroides,* and *Thalassia hemprichii* occur in varying abundances offshore of Nahpali Island. *Cymodocea rotundata* comprises the greatest amount of the above-ground biomass, followed by *T. hemprichii,* and the rare *E. acoroides.* The combined mean biomass of this seagrass community (69.34 g dry weight/ m^2) is comparable to seagrass biomass values from other tropical areas (Table 1). Individual species

Table 1. Comparison of above-ground biomass of tropical seagrasses

Location	Species	Above-ground biomass (grams dry weight/ m^2)	Reference
Palau	*Cymodocea rotundata*	6-13	Ogden & Ogden 1982
	Enhalus acoroides	93-104	
	Thalassia hemprichii	13-107	
Bottles Bay, Papua New Guinea	*Enhalus acoroides*	95.6	Brouns & Heijs 1986
Pari Island, Indonesia	*Enhalus acoroides*	96.5	Azkab 1988
Northern Queensland, Australia	Community Total composed of (in order of abundance): *Halodule uninervis, Cymodocea serrulata, Cymodocea rotundata, Halophila minor* & *Thalassia hemprichii*	60-133	Mellors et al. 1993
Kuta Bay, Indonesia	*Enhalus acoroides*	5.4-15.1	Azkab 1996
Sungai Pulai, Malaysia	*Enhalus acoroides*	7.4-14.1	Ethirmannasingam et al. 1996
Nahpali Island, Pohnpei	*Cymodocea rotundata*	42.53	McDermid & Edward (this paper)
	Enhalus acoroides	4.95	
	Thalassia hemprichii	21.86	
	Community Total	69.34	

biomass values at Nahpali show a higher biomass for *C. rotundata* and lower biomass for *E. acoroides* than reported in previous studies.

Trends in biomass and relative abundance data suggest a zonation pattern of seagrass abundance at this site. The biomass of *Cymodocea rotundata* declined at distances farther offshore, perhaps due to a variety of physical and biological factors present offshore: greater water depth, increased turtle and rabbit fish grazing, less sandy substratum, or stronger currents. On this reef, the distribution pattern of *Thalassia hemprichii* might be caused by grazers, physical factors, or perhaps competitive interactions with *C. rotundata.* In Yap, *Cymodocea* is thought to be a strong competitor in contests with *Thalassia* (Kock & Tsuda 1978). *Enhalus acoroides* has the least biomass in this Nahpali Island seagrass meadow. Substratum, water motion, water depth or even nutrient levels may be factors limiting *E. acoroides* growth in this seagrass meadow. In the nearby Madolenihmw Harbor, water is calmer and more turbid, and *E. acoroides* is the dominant species (personal observation). More quantitative work on seagrass abundance and zonation patterns and ecology in Pohnpei is clearly needed.

Acknowledgements

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Note added in Proofs

A paper (Mukai, H. 1993. Biogeography of the tropical seagrasses in the western Pacific. Australian Journal of Marine and Freshwater Research 44:1–17) was brought to the authors' attention after submitting the article. This paper contains confusing information about seagrass species occurrence in Pohnpei which we did not incorporate into the present article.