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Productivity Measurements of Benthic Communities in Biscayne National Park as an Indication of Ecosystem Health.

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Scientists of the U.S. Geological Survey have developed methods for measuring metabolic rates (productivity) of benthic communities such as coral reefs, seagrass beds, and other hard and sand bottom communities. Research efforts have focused on examining the potential for using benthic community metabolism as an indication of ecosystem health. By examining ecosystem health in terms of system processes or function, comparisons can be made between ecosystems in different geographic locations that might be characterized by different species of organisms. Monitoring efforts have begun in Biscayne National Park, Hawaii, Florida Bay, and Tampa Bay.

Productivity (photosynthesis, respiration, and calcification) was measured on a seagrass bed, patch reefs, and bare sand in Biscayne National Park for 24-hour periods of time (day, night cycles) using a Submersible Habitat for Analyzing Reef Quality (SHARQ, Figure 1).

Figure 1. The Submersible Habitat for Analyzing Reef Quality (SHARQ) is a large-scale underwater incubation chamber designed to isolate a mass of water over the ocean bottom. This enables scientists to measure changes in water chemistry that result from benthic community metabolism and to calculate metabolic rates associated with different types of benthic habitats.

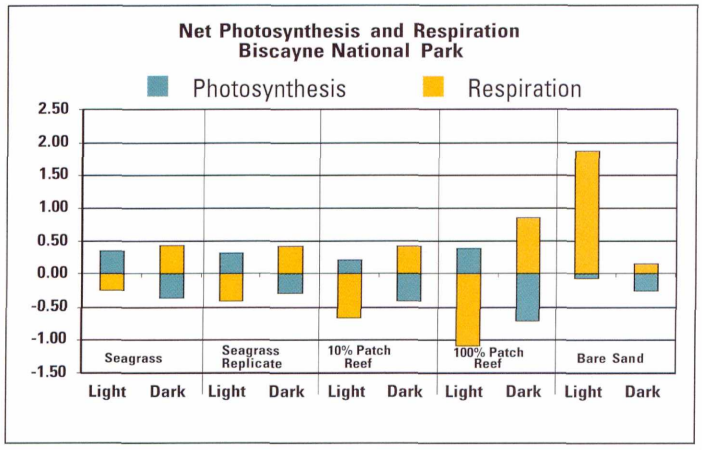

Figure 2. Rates of net photosynthesis and net respiration (g carbon m^{-2} day^{-1}) for seagrass beds, patch reefs and bare sand during day (light) and night(dark).

Initial monitoring exercises were performed between June 25 and July 3 of 2000. Dissolved oxygen, pH, conductivity, and temperature were measured and data logged every 1-minute throughout incubation periods. Water samples were removed and analyzed for total alkalinity every four hours. Photosynthetically active radiation (PAR) was also measured and recorded continuously throughout experiments using a LiCor quantum sensor. Carbonate speciation was calculated from pH and total alkalinity measurements. Net photosynthesis was determined from changes in dissolved oxygen, respiration from changes in total CO2 (derived from carbonate speciation calculations), and calcification from changes in total alkalinity. Metabolic parameters from these experiments are presented in Figures 2 and 3 and Table 1.

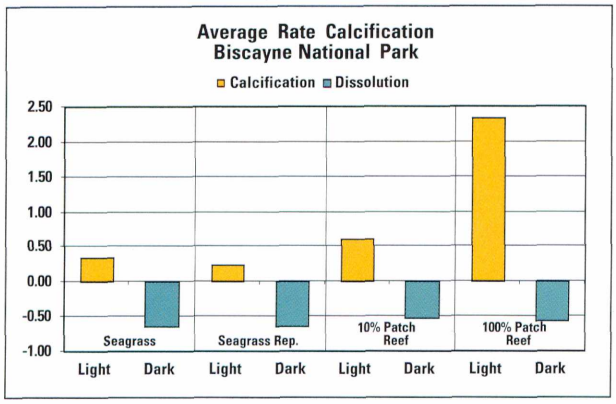

Figure 3. Rates of net calcification (g $CaCO3$ m^{-2} day^{-1}) for seagrass beds, patch reefs and bare sand during day (light) and night (dark).

Net rates of photosynthesis ranged from 0.23 to 0.39 grams of carbon m^{-2} day^{-1} with the highest rates associated with a shallow (2m) patch reef, and lowest rates associated with deeper (6m) seagrass beds and patch reefs. Rates of net day-time calcification ranged from 0.23 to 2.33 grams $CaCO3$ m^{-2} day^{-1} with highest values associated with the shallow patch reef and lowest values associated with the deeper patch reef and seagrass beds. Bare sand measurements indicated net respiration and net dissolution of carbonate sediments during both day and night.

Table 1 Metabolic parameters for representative substrate types of Biscayne Reef Tract.

	Seagrass		Seagrass Replicate		6m Reef		2m Reef		Bare Sand	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Calcification (g $CaCO_3$ m^{-2})	0.34	-0.64	0.23	-0.65	0.61	-0.54	2.33	-0.57	-6.00	-0.68
mmol O_2 m^{-2}	29.1	-29.3	27.1	-24.2	18.9	-33.6	32.8	-59.5	-5.4	-20.7
P from O_2 (g C m^{-2})	0.35	-0.35	0.32	-0.29	0.23	-0.40	0.39	-0.71	-0.07	-0.25
R from TCO_2 (g C m^{-2})	-0.228	0.438	-0.395	0.418	-0.662	0.428	-1.075	0.864	1.875	0.158
C:D	-	0.53	-	0.35	-	1.13	-	4.10	-	8.78
P:R from O_2 day:O_2 night	-	1.00	-	1.12	-	0.56	-	0.55	-	0.26

This is the first year of our monitoring efforts in Biscayne National Park. These preliminary data are comparable to similar measurements performed on patch reefs located on the reef flat along the south coast of Molokai, Hawaii during February 2000. Although these rates are also similar to average rates reported for South Pacific Reef flats and coral/algal zones before 1985, photosynthesis/respiration ratios are generally lower (Figure 4.). Additional experiments will be performed throughout the duration of this project to verify these data and establish trends.

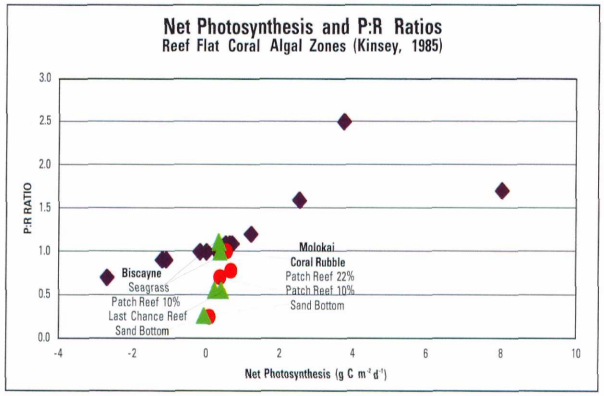

Figure 4. Net photosynthesis and photosynthesis/ respiration (P:R) ratios for Biscayne (green), Molokai (red), and other South Pacific benthic reef communities (blue).

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