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SELINA TIRTAJANA: Wesleyan University

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DIATOM STRATIGRAPHY OF SMUGGLER'S COVE, ST. CROIX, US VIRGIN ISLANDS

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INTRODUCTION

Diatoms (Class Bacillariophyceae) are a group of microscopic algae living in aquatic habitats. They are easily recognized by their siliceous (opaline) cell walls, which are well preserved long after burial and taxonomically diagnostic. Diatoms are useful indicators of environmental change since their abundance depends on nutrient level, water currents, light availability, salinity, and substrate type (MacIntyre et al. 1996; Forster et al. 2006). As part of a larger effort to reconstruct the paleoenvironment of Tague Bay lagoon in Smuggler's Cove, St. Croix, US Virgin Islands, this study aims to document the abundance and species assemblage of diatoms in the sediments and test whether differences in species assemblage and abundance occur among different substrate types (geographical location) and with depth in the substrate.

STUDY AREA

Smuggler's Cove is a back reef lagoon located between the island of St. Croix and a bank barrier reef to the north of the island (Figs. 1 & 3, Hubbard et al., this volume). The gently sloping seafloor of Smuggler's Cove is covered by alternating zones of mixed benthic vegetation and carbonate sand "blow-outs". Benthic vegetation in the area includes sea-grasses (*Thalassia testudinum*, *Syringodium filiforme*, and *Halodule wrightii*) and macroalgae (*Halimeda*). In areas where sea grass meadow is patchy, a burrowing shrimp species, *Callianassa rathbunae*, creates an undulating surface of sand mounds and valleys.

The surface and core samples contained an average of fourteen thousand diatom valves per gram of wet

sediment; significantly lower than the diatom counts obtained in other studies around the area. In addition, the diatom species assemblage and abundance data suggests environmental change in the past with respect to vegetation cover.

METHODS

Field Methods

Thirteen sediment cores were collected from Smuggler's Cove, St. Croix, USVI in August 2007 using a hydraulic vibracore. At all sample locations, GPS location was obtained and the condition of the substrate recorded. For this study, three cores were selected (SC1, SC3, and SC6) to represent three different environments (substrate types). SC1 was located in the middle of *Callianassa* shrimp mounds; SC3 in a sea grass (*Thalassia testudinum*) meadow; SC6 in the middle of a bare carbonate sand patch. At shore, the cores were dissected and sub-sampled at 5 or 10cm intervals. Samples were kept at 4°C until the preparation stage.

Sample preparation and analysis

Sample preparation followed a method modified from Battarbee (1986). Approximately 1.0 gram of wet sediment (mostly containing calcium carbonate sand) is completely dissolved in 15ml of 10% hydrochloric acid. The substrate is then washed thoroughly to remove all traces of acid by repeatedly centrifuging (3 minutes at 2,500 rpm) and re-suspending the sample in distilled water. Afterwards, 10ml of 25% hydrogen peroxide is added to the substrate, and heated in 80°C water bath for 4 hours or more, until all organic material has been

removed. The solution is then centrifuged, washed with distilled water, and re-suspended in 1ml of distilled water.

Enumeration and statistics calculation

Using a micropipette, 5µl of the diatom concentrate is mounted on an aluminum stub, sputter-coated with gold and examined at x1000 magnification with a JEOL JSM-5610LV Scanning Electron Microscope (SEM). Diatoms were enumerated and identified to species/genus level (whenever possible) along median transects using the following literature and keys: Round et al. 1990; Navarro et al. 1997; Hagelstein 1938. Diatom fragments were counted and identified, but only when more than half of the valve was intact.

There were very few identifiable diatom valves present in sample intervals deeper than 50cm, even though there were many sponge spicules, radiolarians and phytoliths present in these samples. In addition, approximately 30% of all the diatoms found in the 15 samples could not be identified because (a) several identifying aspects of the specimen could not be viewed under the SEM, (b) poor specimen quality, (c) some forms have not been previously described from the area.

Species richness was counted as total number of species per sample. However, in order to obtain a more reliable measure of species richness, evenness should be considered. Hence, the Shannon-Wiener diversity index was calculated, which incorporates both richness and evenness, using the following formula:

$$H' = - \sum_{i=1}^S p_i \ln p_i$$

n_i : number of diatoms in each species

s : number of species / species richness

N : total number of all diatoms in the sample

p_i : relative abundance of each species

The diatom species were then divided into two categories: pennate and centric, and the ratio of abundance between the two categories were calculated to obtain the centric : pennate ratio (Pyle et al. 1998). Lastly, diatom abundance in the sediment was ob-

tained using the following formula:

$$\text{Abundance (cells g}^{-1}\text{)} = \frac{\text{(diatom count in a stub} \times 10^{-3}\text{ L)} / \text{weight (in g) of wet sediment}}{5 \times 10^{-6}\text{ L}}$$

RESULTS AND DISCUSSION

General Observations

A total of thirty diatom species in the class Bacillariophyceae were observed (see Figure 3&4 for SEM photomicrographs of common diatoms found in the sediments). In general, the diatom species represented in these cores are more or less similar to that of other areas in the Caribbean (Hagelstein 1938, Navarro et al. 1989, Pyle et al. 1998, Corlett and Jones 2007, Gordon et al. 2008). The most abundant taxa were *Mastogloia sp.*, *Navicula sp.*, *Diploneis sp.*, *Cocconeis sp.*, and *Nitzschia sp.* These five taxa together represented more than 85% of the total abundance. For a complete list of all species enumerated in the samples and their relevant statistics, see Appendix 1.

The overall average of diatom abundance is about fourteen thousand valves per gram of wet sediment, which is relatively lower than the results obtained by similar research in other tropical and sub-tropical locations. Gottschalk et al. (2007) reported an overall average diatom abundance of 2.55×10^6 cells ml^{-1} in Great Barrier Reef, and Pyle et al. (1998) reported about 3 to 10 million samples per gram of sediment. The low concentrations of diatoms found in this study could be due to the hot peroxide treatment during diatom extraction, which might have dissolved some of the diatom valves.

As expected, estimates of diatom concentration in all three cores decreases with depth (Fig. 1D). This trend might reflect recent increase in benthic productivity, although it is most likely caused by variable sedimentation rates and differential dissolution of diatom frustules. Furthermore, since the diatoms are of varying sizes and shapes, the concentration in number of valves per volume (grams of wet sediment) does not fully reflect diatom productivity.

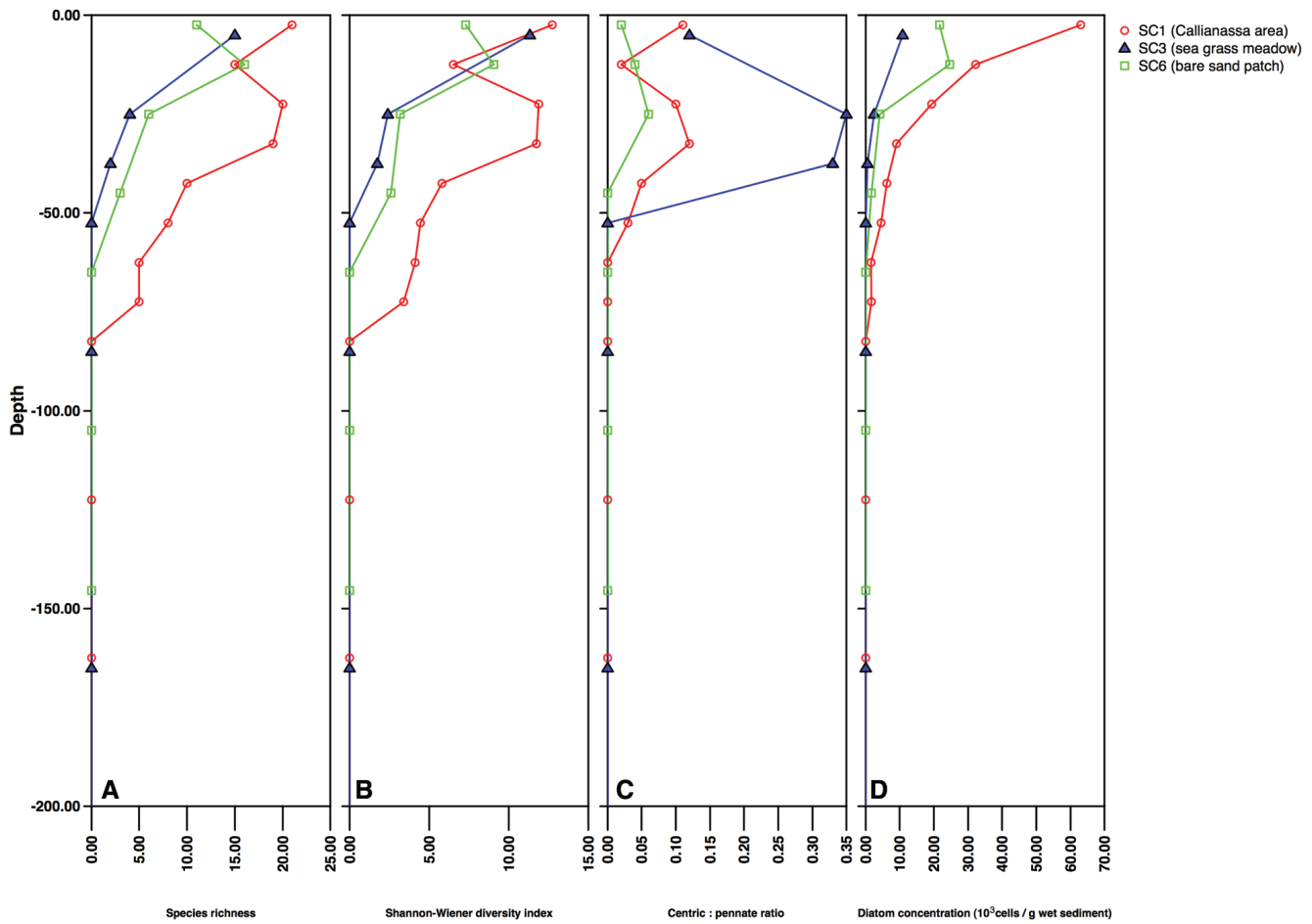


Figure 1. Species richness, centric:pennate ratio, and diatom concentrations of sediment samples in cores. Zero depth is the sediment surface.

A more accurate measure of productivity can be obtained by extracting and measuring the amount of diatomaceous silica in the sediment and correlating it with the sedimentation rate to reflect the creation of biogenic silica by diatoms over time.

The relative proximity of the core locations to coral reefs might have also affected the low concentration of diatoms in the sediment. Coral reefs are generally regarded as oligotrophic marine ecosystems with low levels of dissolved inorganic nutrients, which are necessary for phytoplankton growth (Underwood 2002). Therefore we might expect reef environments to have low diatom concentrations. Furthermore, strong wave action in the area may not provide an environment conducive for diatoms to settle.

Species Richness and Diversity

Species richness and Shannon-Wiener diversity measures of diatom assemblages fluctuate together in all the cores (Fig. 1A & 1B). In general, deeper samples tend to have lower species richness and diversity as fewer and fewer species are able to withstand the diagenetic process.

For SC1, the bioturbated *Callianassa* area, diversity is highest in the 20-30cm and 30-40cm intervals and lowest in the 10-20cm interval, which coincides with the diversity peak of SC6, the bare sand environment. The seagrass environment (SC3) shows a steady loss in diversity down core.

There appears to be a gradually increasing trend in diatom community diversity with time. A regression analysis could be performed to confirm this hypothesis, although a greater number of samples taken at higher resolution would be necessary to test this. In addition, the integrity of sediment stratigraphic

phy in the core needs to be established first to ensure that there is a reliable relationship between depth and time (ie. older sediments are always buried under the newer ones).

Centric to Pennate Ratio

Diatom species can be broadly categorized into three classes: centric, araphid, and raphid. Araphid and raphid diatoms are pennate diatoms, which are benthic, whereas centric diatoms are generally planktonic species. The ratio of centric to pennate forms indicates the relative availability of planktonic and benthic habitats (Cooper 1995). An environmental change that causes a decrease in the availability of benthic habitat can be reflected in an increased c:p ratio as centric species gain a competitive advantage.

The c:p ratio (Fig. 2C) does not show significant changes in both the *Callianassa* shrimp area (SC1) and the bare sand area (SC6), although in SC3 (seagrass) there is a large increase in c:p ratio from 0.12 in the surface sample to 0.35 in the 20-30cm sample. This increase may suggest that there are environmental changes, which promote blooms of centric diatoms and/or retard the population of benthic diatoms. Several possible causes are (i) a higher level of suspended sediment/nutrients that increases turbidity and reduces light availability to the benthic species; (ii) reduction in the area of sea grass meadow that provides habitat for the mostly epiphytic benthic diatoms; (iii) increased water depth, which decreases the light availability for the benthic species.

Using vegetation census data, Ferguson et al. (2007) noted that there has been an overall increase in sea grass density from 1980 to 2002, based on an increase in the relative abundance of *Thalassia* throughout the study area. The proliferation of sea grass meadows in the area would explain the decrease in c:p ratio in the grassbed surface sample as the sea grass meadows provide more habitat for pennate forms.

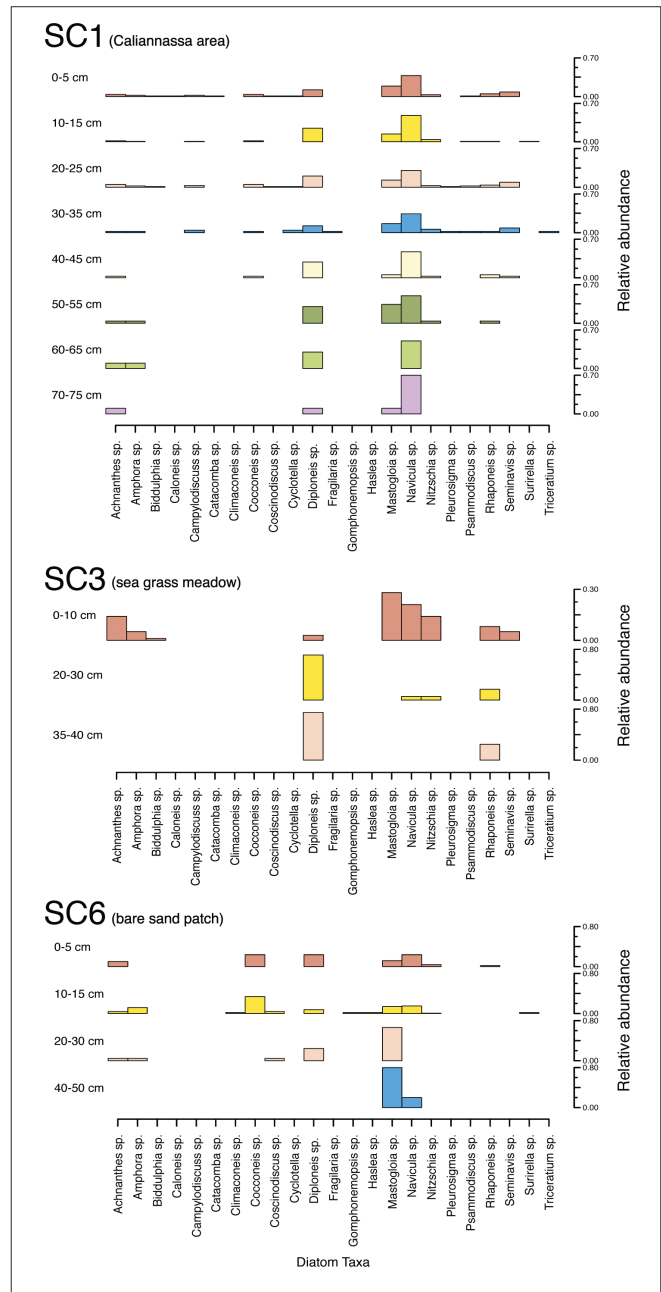


Figure 2. Genus-level diatom assemblage data from cores SC1, SC3, and SC6.

Diatom Assemblage Data

The diatom assemblage data (genus-level) in Figure 2 illustrate a possible diatom taxonomic fingerprint, which is unique to the core location. The species composition of diatoms in core SC1 is consistent throughout the core, with *Navicula sp.* and *Diploneis sp.* dominating the assemblage. This could be a result of a stable environment in the area, or alternatively, a consequence of bioturbated sediment

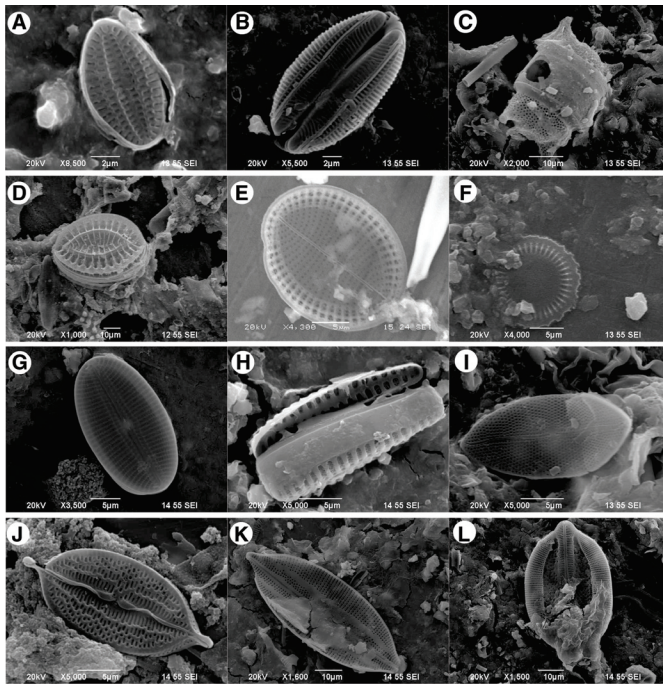


Figure 3. SEM photomicrographs of diatoms found in Smuggler's Cove sediment. A) *Achnanthes* sp., B) *Amphora* sp., C) *Biddulphia* sp., D) *Campylodiscus ubangularis*, E) *Cocconeis* sp., F) *Cyclotella* sp., G) *Diploneis* sp., H) *Gomphonemopsis* sp., I) *Mastogloia pusilla* Grunow, J) *Mastogloia Corsicana* Grunow, K) *Mastogloia elegans* Lewis, L) *Mastogloia erthrea* Grunow.

leading to uniform stratigraphy.

On the other hand, the species assemblage in the surface sediment of the seagrass bed core SC3 (0-10cm) shows a distinct pattern that is different from the rest of the core. *Mastogloia* sp., *Navicula* sp., and *Nitzschia* sp. are the three dominant taxa in the surface sample, whereas *Rhaponeis* sp. and *Diploneis* sp. are the dominant taxa in deeper intervals. Corlett et al. (2007) also observed the lack of correspondence between taxa found in the leaves of *Thalassia testudinum* and the biota found in the sediments of the meadows. Most of the epiphytic diatoms in the sediment samples of Corlett et al. were badly fragmented and partially dissolved even though coralline algae and foraminifera in the same sample did not show any sign of dissolution; similar to my results. Corlett et al. (2007) suggested these epiphytic diatom remains may have been transported out of the lagoon by storms that actively winnow the lagoon sediments. This hypothesis can be corroborated by the sharp decrease in the diatom concentra-

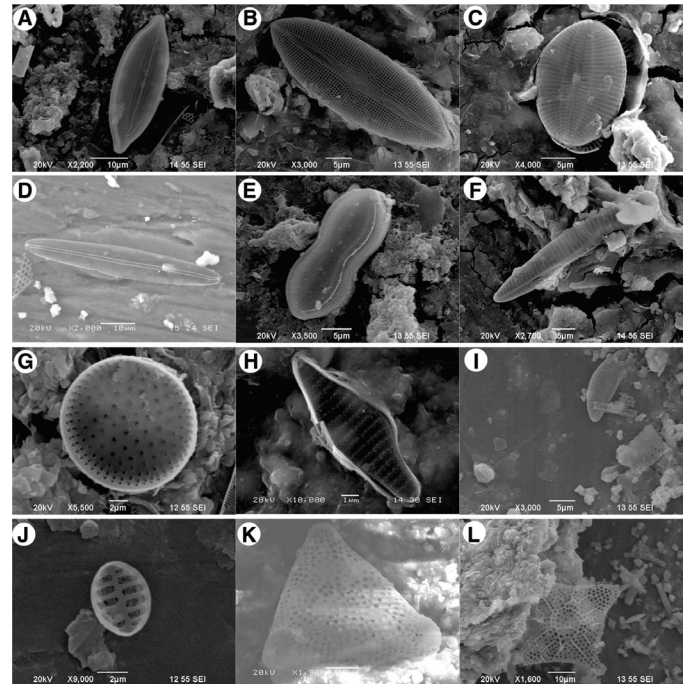


Figure 4. SEM photomicrographs of diatoms found in Smuggler's Cove sediment. A) *Mastogloia ovalis* A. Schmidt, B) *Mastogloia smithii* Grunow, C) *Navicula* sp., D) *Navicula cf. zostereti* Grunow, E) *Nitzschia* sp., F) *Pleurosigma* sp., G) *Psammodiscus* sp., H) *Rhaphoneis* sp., I) *Seminavis ventricosa* (Gregory) Garcia-Baptista, J) *Surirella recedens* A. Schmidt, K&L) *Triceratium* sp.

tion between the 0-10cm interval and the subsequent intervals, suggesting a large-scale removal of diatoms from the surface sediment.

For SC6 (bare carbonate sand patch), the species assemblage is consistent for the first 15 cm, with *Cocconeis* sp. being the dominant taxon. This genus, however, disappears at the deeper intervals and *Mastogloia* sp. becomes the dominant taxon. Since *Cocconeis* sp. is an epiphytic diatom that lives on the surface of algae and sea grasses, it is most likely that the valve remains of these diatoms come from the surrounding sea grass meadows. Hence, the recent appearance of this taxon in the sediment can also be tied to the proliferation of sea grass meadows.

CONCLUSIONS

The diatom assemblage analysis of sediments obtained from Smuggler's Cove provides us with a glimpse of environmental change in the past, such as change in area of substrate cover. Nonetheless, given

the low resolution of the study, we need to correlate the data with other paleoecological indicator data (eg. molluscan death assemblage, grain size, geochemistry) to be able to reconstruct a more complete picture of past environments.

REFERENCES

- Battarbee R. 1986, Diatom analysis. In *Handbook of Holocene Palaeoecology and Palaeohydrology* (ed. B. BE), pp. 527-570. Wiley.
- Cooper, S.R. 1995, Diatoms in sediment cores from the mesohaline Chesapeake Bay, U.S.A. *Diatom Research* v. 10(1), p. 39-89.
- Corlett H. and Jones B. 2007, Epiphyte communities on *Thalassia testudinum* from Grand Cayman, British West Indies: Their composition, structure, and contribution to lagoonal sediments. *Sedimentary Geology* v. 194(3-4), p.245-262.
- Ferguson C. A. and Miller A. I. 2007, A sea change in Smuggler's Cove? Detection of decadal-scale compositional transitions in the subfossil record. *Palaeogeography Palaeoclimatology Palaeoecology* v. 254(3-4), p. 418-429.
- Forster R. M., Creach V., Sabbe K., Vyverman W., and Stal L. J. 2006, Biodiversity-ecosystem function relationship in microphytobenthic diatoms of the Westerschelde estuary. *Marine Ecology-Progress Series* v. 311, p. 191-201.
- Gordon N., Adams J. B., and Bate G. C. 2008, Epiphytes of the St. Lucia Estuary and their response to water level and salinity changes during a severe drought. *Aquatic Botany* v. 88(1), p. 66-76.
- Gottschalk S., Uthicke S., and Heimann K. 2007, Benthic diatom community composition in three regions of the Great Barrier Reef, Australia. *Coral Reefs* v, 26(2), p. 345-357.
- Hagelstein, R. 1938, The Diatomaceae of Porto Rico and the Virgin Islands. *Scientific Surveys of Porto Rico and the Virgin Islands* v. 8(3) p. 313-444.
- Laura Pyle S. R. C., Jacqueline K. Huvane. 1998, *Diatom Paleoecology Pass Key Core 37, Everglades National Park, Florida Bay*. USGS.
- MacIntyre H. L., Geider R. J., and Miller D. C. 1996, Microphytobenthos: The ecological role of the "secret garden" of unvegetated, shallow-water marine habitats 1. Distribution, abundance and primary production. *Estuaries* v. 19(2A), p. 186-201.
- Navarro J. N. and Hernández-Becerril D. U. 1997, Check-list of marine diatoms from the Caribbean Sea. Instituto de Biología, Universidad Nacional Autónoma de México.
- Round F. E., Crawford R. M., and Mann D. G. 1990, *The Diatoms: biology & morphology of the genera*. Cambridge University Press.
- Underwood G. J. C. 2002, Adaptations of tropical marine microphytobenthic assemblages along a gradient of light and nutrient availability in Suva Lagoon, Fiji. *European Journal of Phycology* v. 37(3), p. 449-462.

	SC1 (<i>Callianassa</i> shrimp mounds)							SC3 (sea grass meadow)			SC 6 (sand blowout)				
	0-5	10-15	20-25	30-35	40-45	50-55	60-65	70-75	0-10	20-30	35-40	0-5	10-15	20-30	40-50
	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm
No. of diatoms counted	324	186	106	49	35	24	10	10	76	17	4	148	162	24	10
Species richness (no. of species per sample)	21	15	20	19	10	8	5	5	15	4	2	11	16	6	3
Shannon Wiener diversity index	12.74	6.53	11.87	11.75	5.8	4.44	4.13	3.41	11.32	2.42	1.75	7.29	9.07	3.17	2.59
Centric : pennate ratio	0.11	0.02	0.1	0.12	0.05	0.03	0	0	0.12	0.35	0.33	0.02	0.04	0.06	0
Cells per gram of wet sediment (in thousands)	63.07	32.26	19.30	9.06	6.23	4.54	1.64	1.68	10.83	2.42	0.6	21.71	24.66	4.2	1.65
<i>Achnanthes</i> sp.	0.04	0.02	0.05	0.02	0.03	0.04	0.10	0.10	0.14			0.1	0.04	0.04	
<i>Amphora</i> sp.	0.02	0.01	0.02	0.02	0.02	0.04	0.10	0.10	0.05				0.12	0.04	
<i>Biddulphia</i> sp.	0.01		0.01						0.01						
<i>Caloneis</i> sp.	0.01														
<i>Campylodiscus abangularis</i> Grunow	0.02	0.01	0.03	0.04											
<i>Catacomba</i> sp.	0.01														
<i>Climacometis scopuloroides</i> Husted													0.02		
<i>Cocconeis</i> sp.	0.04	0.02	0.05	0.02	0.03							0.24	0.34	0.04	
<i>Cocconeis</i> sp.	0.01		0.01										0.04	0.04	
<i>Cyclotella</i> sp.	0.01														
<i>Diploneis</i> sp.	0.12	0.25	0.20	0.12	0.29	0.30	0.30	0.10	0.03	0.71	0.75	0.24	0.08	0.24	
<i>Fragilaria tabularia</i> var. <i>abularia</i> (Agardh) Lange-Bertalot															
<i>Gomphonemopsis exigua</i> (Kützting) Medlin															
<i>Haslea ostrearia</i> (Gailion) Simonsen															
<i>Mastogloia corsicana</i> Grunow	0.06	0.06	0.05	0.10	0.03				0.16			0.04	0.1	0.62	0.6
<i>Mastogloia elegans</i> Lewis	0.05	0.02	0.02	0.04	0.03	0.04		0.10				0.02	0.02	0.04	
<i>Mastogloia ovalis</i> A.Schmidt	0.02	0.01	0.04						0.03			0.02	0.02		
<i>Mastogloia pusilla</i> Grunow									0.03						
<i>Mastogloia smithii</i> Grunow	0.06	0.07	0.02	0.02					0.03			0.04			0.2
<i>Mastogloia</i> sp.									0.03						
<i>Navicula</i> cf. <i>congenera</i> Hugelstein	0.03	0.02	0.01	0.02					0.03				0.01		
<i>Navicula</i> cf. <i>zostereti</i> Grunow	0.30	0.40	0.25	0.30	0.37	0.46	0.40	0.60	0.13	0.06		0.2	0.12	0.2	
<i>Navicula</i> sp.	0.05	0.06	0.04	0.02	0.10	0.04	0.10	0.10	0.05			0.04	0.02		
<i>Nitzschia</i> sp.	0.03	0.04	0.03	0.06	0.03	0.04			0.14	0.06		0.04	0.01		
<i>Pleurosigma</i> cf. <i>strigosum</i> Wm. Smith															
<i>Psammodiscus</i> sp.	0.01	0.01	0.02	0.02											
<i>Rhaponis</i> sp.	0.05	0.01	0.04	0.02	0.06	0.04			0.08	0.17	0.25	0.02			
<i>Scutinaea ventricosa</i> (Gregory) Garcia-Baptista	0.08		0.09	0.08	0.03				0.05						
<i>Swirella fanosa</i> (Ehrenberg) Kützting															
<i>Triceratium</i> sp.															

Note: Sediment intervals that do not contain diatoms are omitted from the table.