REEF MORPHOLOGY AND SEDIMENT ATTRIBUTES, ROATAN, BAY ISLANDS, HONDURAS

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ABSTRACT: A reef monitoring program off Roatan, Bay Islands, Honduras has produced base line data for platform bathymetry, major macrofauna distribution, and sediment attributes. Because erosion accompanying accelerated island development will be increasing in the near future, measurements of total suspended solids and sedimentation rate were made. Results show TSS range from 8 to 70 mg/l in the summer and 30 to 222mg/l in the winter. Sedimentation rates in the fore reef, where finer-grained terrigenous material would potentially accumulate, are 0.14mg/cm^2/day to 7.07mg/cm^2/day in the summer and 41 to 71mg/cm^2/day in the winter. The summer values are well within the ranges of published results from other Caribbean carbonate platforms, however winter values are up to ten times that of other localities.

KEY WORDS: coral reefs, Roatan, Honduras, carbonate platforms, sedimentation rates

INTRODUCTION

Unlike the well-known Belize region to the north, the Bay Islands reef tract has received little attention and is known mostly as a premier recreational diving destination. The only published geologic studies of the Bay Islands include McBirney and Bass (1967), Kornicker and Bryant (1967) and Lallemant and Gordon (1999). Luttinger (1997) published a review paper on local conservation efforts. In this paper we present results of our initial efforts to describe the reef morphology, sediment characteristics, and faunal zonation for a portion of the reef tract around Roatan, the largest of the Bay Islands, Honduras.

The Bay Islands, located approximately 60km off the north coast of Honduras, are the southernmost part of the Meso-American reef tract, the second longest reef tract in the world after the Great Barrier Reef of Australia. Roatan is a relatively small island, only 40 km long and 1-3 km wide known primarily for its excellent recreational diving (Fig. 1). However, the island is on the brink of rapid changes associated with improved access and increased development. Accompanying this development will come increased stresses on the reef environment in the form of diminished water quality, both in terms of nutrient loading and siltation from increased runoff (Fig. 2).

In the summer of 1998 the authors initiated a long-term monitoring program to determine patterns of sediment accumulation, spatial distribution, and terrigenous sediment input. This paper presents the initial results of this ongoing study.

Figure 1. Aerial view of the northern side of Roatan Island, looking east. The steep-sloped mountainous backbone of the island, and shorelines with various degrees of clearcutting, are visible. The reef on this portion of the island is a barrier, with the lagoon up to a quarter of a mile wide.

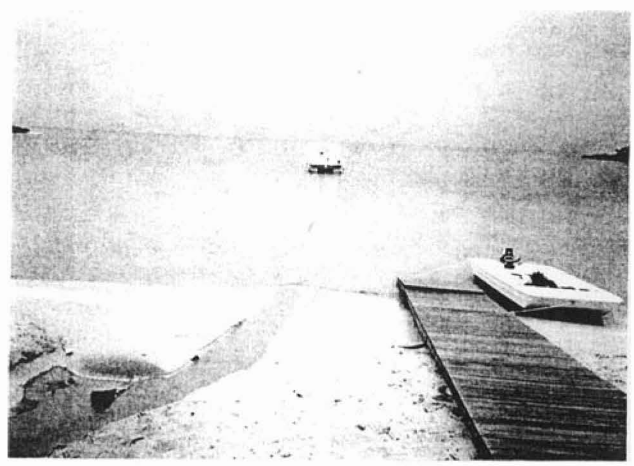


Figure 2. Sediment plume of opaque red color entering Half Moon Bay after a summer storm, July, 1999. Although shoreline sediment can have large amounts of terrigenous material, lagoonal and reef sediments are almost entirely pure carbonate. Suspended sediment and sediment trap data indicates that this suspended terrigenous sediment moves to deeper water (fore-reef and ultimately off platform) before deposition.

GEOLOGIC SETTING

Roatan is the largest of the islands comprising the Bay Islands east of mainland Honduras (16°18'N, 86°35'W). The Islands are bordered immediately to the north by the Cayman Trough, and Roatan steps into the trough via gently sloping platforms at 100, 500 and 1,000 fathoms(Kornicker and Bryant 1967). The south shore of the island drops off steeply (20 fathoms within 250-500 m from the shore) to the continental shelf which gradually shallows in the 30 km between Roatan and mainland Honduras. The shelf between Honduras and the Bay Islands ranges between 5 and 20 fathoms in depth (Kornicker and Bryant 1967). The origin of the Bay Islands is attributed to wrench faulting associated with strike-slip motion in the Cayman Trough (Pindell and Barrett 1990). The Bay Islands are part of an en echelon series of ridges forming the southern margin of the Cayman Trough. This interpretation is substantiated by a prominent uplifted terrace of 34,300 ± 480 ybp (Cox 1998) reefal limestones along the southwestern shore of Roatan. This C^{14} -based age has, on the basis of U-series dating of dripstone within the reef, been revised to approximately 135Ka (Cox, personal communication). Lallemant and Gordon (1999) document a much older uplift and unroofing event of Roatan in the latest Eocene-Early Oligocene. With the exception of the limestone terrace along the south shore and isolated exposures of serpentinite, the bedrock of Roatan is predominantly metasedimentary (Peterson et al. 2000).

There is no existing detailed oceanographic data for the island of Roatan. Kornicker and Bryant (1967) report that the islands are characterized by semidiurnal tides approximately 3.5 feet in height. The Bay Islands experience west-northwest currents originating from the Equatorial Current sweeping northwest from Venezuela and Colombia. Local currents around Roatan experience seasonal directional changes, flowing southward and eastward in the winter and westward and northwestward in the summer. Prevailing winds shift from northerly and westerly in the winter to easterly and southeasterly in the summer. Water temperatures measured on the reef and lagoon during July, 1998 were 84-88°F. Salinity values were not available. Air temperatures are reported to range from 70°F in the winter to the 90°'s in the summer (Kornicker and Bryant 1967). Roatan is a wet tropical island, however rainfall comes in very intense pulses occurring mostly during the October-March rainy season. Precipitation data collected from 1996 to 2000 (Mehrtens, unpublished data) record average monthly rainfall values ranging from 3 inches per month in June to greater than 50 inches per month in November. Even during the dry season, tropical systems have the propensity to drop large amounts of precipitation over the island in short periods of time. Prior to Hurricane Mitch in 1998 the previous major tropical depression was in the early 1960's. During July in 1998, 1999 and 2000, tropical wave type storms dropping up to and in excess of one inch per hour were observed by the authors. Such quick pulses of heavy precipitation are very capable of transporting the lateritic soil of the island seaward, and red colored plumes of terrigenous sediment were clearly visible as they entered the lagoon. There are over 80 small (<1-2.5km^2) watersheds on Roatan, each drained by small ephemeral streams, the most developed of which are capable of discharging large terrigenous plumes (Fig. 2). The observed plumes dissipated within 12 hours of each storm.

The reef surrounding Roatan is in places both fringing and barrier in nature. The lagoon varies in width from zero to 700 meters and in depth from zero to 3 meters and is commonly covered by Thallassia patches. In some places the lagoon/ shoreline interface is populated by black mangroves (Rhizopora nigra), but in most locales the mangroves have been removed. The reef, a southern extension of the Belize reef complex, is spectacular. Prominent reef building coral includes species of: Montastrea, Agaricia, Porites, Siderastrea, Diploria, Madracis, Colpophyllia, Mycetophyllia, and Acropora. There are abundant sponge, tunicate, bryozoan, and hydrozoan species. On the northern shore, the reef is characterized by a broad reef crest dissected by spur and groove structures descending through the fore reef to a depth of approximately 15 meters. A narrow shelf separates this wall from the next, which drops off to a depth of approximately 25 meters. On the south shore of Roatan the uplifted limestone terrace produces a different regime. The reef occurs as a barrier offshore from the surf zone. Little sediment accumulates in the back reef area; Siderastrea-encrusted rock pavement is characteristic until depths of 4 or more meters are reached, at which point sediment begins to accumulate in and around the reef. Spur and groove is not present. The reef is characterized by a series of down-dropped terraces which are the seaward extension of the one visible on land.

Study Sites

In order to document bathymetry, live:dead coral ratios, substrate composition and relative coral abundance, transects were completed from the shore seaward to the reef at three localities on the northwest coast of Roatan (Fig. 3): Half Moon Bay, West Bay, and furthest to the west, West Bay Beach, a popular tourist site. Sediment traps were installed in the fore reef at three locations: West Bay, Sandy Bay and, mid-way between these, west of Half Moon Bay. Figure 3 locates sample sites. Calibrated rods to measure sediment mobility were installed at 8 different locations on both the northwestern and southwestern shores. Five hundred milliliter water samples were also taken at these same sites. Many other studies sites have been established (Fig. 3) for water quality, sediment grain size and coral cover study.

Methodology

In order to determine bathymetry across the reef, transect lines marked in meter intervals were laid on the substrate along specific compass headings from the shoreline seaward to popular dive location buoys. Depth was measured along the

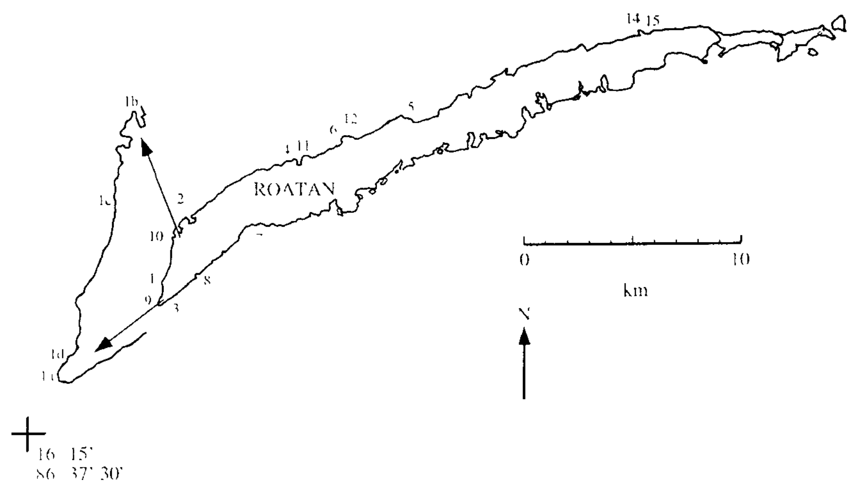


Figure 3. Locality map for sites around the island of Roatan, Bay Islands, Honduras. 1a = Half Moon Bay; 1b = Gibson Bight ; 1c = Herbie's Fantasy; 1d = West Bay Beach; 2 = Sandy Bay; 3= Key Hole; 4 = Turtling Bay; 5 = Hyatt; 6 = Crawfish Point; 7 = Big Key; 8 = Mangrove Bight; 9 = Lighthouse Point; 10 = El Alguila ; 11 = Palmetto Point; 12 = Milton Bight; 14 = Paya Bay; 15 = Camp Bay.

transect by using a combination of weighted line marked in half meter increments and in deeper water, by dive computer. Depth measurements were made every 10 meters, and where depth changed rapidly, every 5 meters. Data was compiled to produce three bathymetric profiles. One meter square grid counts were made every ten meters along a transect. Within each square meter, visual estimates were made of the percent of type of bottom cover (sand: rock pavement: Thallassia) and the percent of substrate covered by select plants and living macroinvertebrates (erect red algae, brown and green algae, scleractinian coral, hydrocoral and octocoral, sponges, tunicates and echinoderms). This data is presented in a series of relative percentage vs. depth diagrams. Because of the small number of grid counts made at each transect point, a species can be locally present, but not found within the meter square grid. Sediment mobility in the back reef and lagoonal settings was determined by the installation of calibrated rods, measured approximately every six months to determine net gain or loss. Sediment size and composition were determined by sieving bottom grab samples at the same localities where mobility measurements were made, as well as from adjacent beaches. Insoluble residue percentages were made from comparison of pre- and post-acid wash weights. Identification of the sand and coarser size grade was made visually, and finer-grained fractions were X-rayed. Suspended sediment was determined by repeated collecting and filtering of 500ml water samples as well as retrieval and filtering of sediment traps placed in several fore reef locations.

RESULTS

Bathymetry

The Half Moon Bay (Fig. 3, locality 1a) and West Bay (Fig. 3, locality d) transects extended from shore seaward across the lagoon to the barrier reef. The West Bay Beach transect was completed in order to produce a bathymetric profile across an area where the reef became fringing.

In general, the bathymetric profiles (Fig. 4) exhibit near shore zones of water depths less than 3 meters, shallowing over the back reef region, gradually deepening before the outer reef is reached and then steeply dropping across the reef wall to the base of the fore reef terrace. The fringing character of the reef at West Bay Beach is illustrated by the absence of a Thallassia-floored "basin" between the shoreline and the back reef, a feature which is prominent at West Bay and present at Half Moon Bay. The variable bathymetry produced by spur and groove structure on the reef crest is visible on the Half Moon Bay transect between 500 and 550 meters, and on the West Bay transect between 230 and 280 meters.

Substrate Type

Pavement refers to cemented carbonate rock, recognizable in thin section as older reefal material. It forms the substrate to living reef as well as dead reef zones. Sand refers to poorly sorted carbonate sediment, consisting of Halimeda, mollusks, echinoderm, red algae and coral fragments. This substrate is frequently burrowed by Callianassa shrimp, clams and at one locality, resting turtles. In places this substrate type is rippled

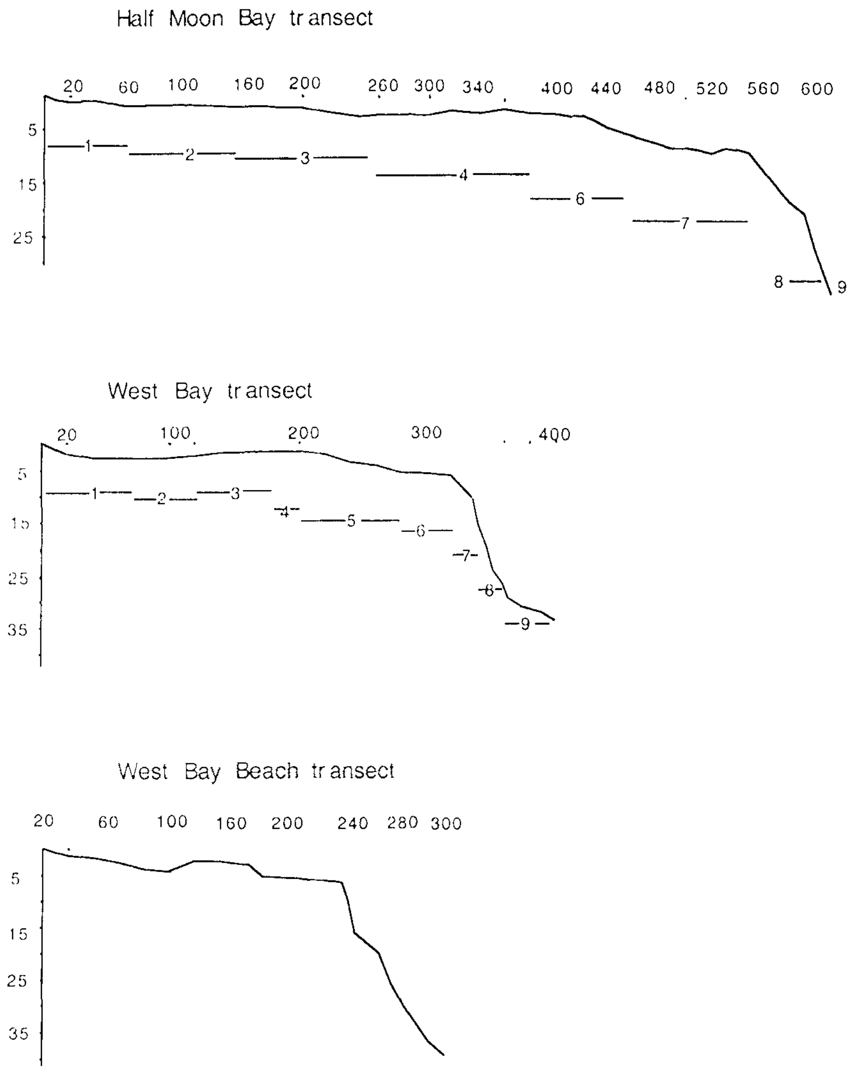


Figure 4. Bathymetric profiles for West Bay, West Bay Beach and Half Moon Bay (see Figure 3 for locations). The Thallassia-floored basin is clearly visible in the West Bay and West Bay Beach transects. The terraced fore-reef is visible on all profiles.

(ex, λ = 20cm, λ = 4cm). Thallassia refers to substrate composed of poorly sorted carbonate sediment covered with growth of the marine grass Thallassia, although calcareous green algae (Halimeda, Udotea, Penicillus) and Syringodium may also be present. Figure 5 illustrates the distribution of the three substrate types across the three transects. Thallassia is most abundant in the broad lagoon of Half Moon Bay and to a lesser extent at the West Bay lagoon. It is absent at West Bay Beach, where the back-reef region is entirely rippled sand. The bulk of all three transects show inversely varying abundance of sand and pavement. Four patterns emerge: (1) the inner lagoon areas are entirely sand or sand and Thallassia. (2) the fore reef terrace is entirely sand; (3) the back reef and reef crest regions exhibit the greatest variation in sand:pavement ratios, which reflects spur and groove structure and sand pockets within the reef framework. (4) a "sand moat" (cf. Kaplan 1982) between the back reef and reef crest regions, is recognizable at West Bay (280-320 meters) and West Bay Beach (170-230 meters).

Percent Live Cover

Every 10 meters along the transect a visual estimate of the percent of a one meter square area covered by living coral, hydrocoral, octocoral, and sponge was determined (Fig. 6). The stony corals and their relatives exhibited their greatest concentrations where the pavement formed the substrate. Thus, at all three localities studied, the percent live cover was lowest nearshore where sand and Thallassia-covered sediment formed the substrate, as well as the in the outer sand belt (Zone 6, see below) and fore reef terrace (Zone 9). The percentage of the substrate occupied by stony coral, octocoral, hydrocoral and sponge was greatest where there are exposures of older dead reef material of the back reef (Zones 4 and 5) and reef crest (Zones 7 and 8).

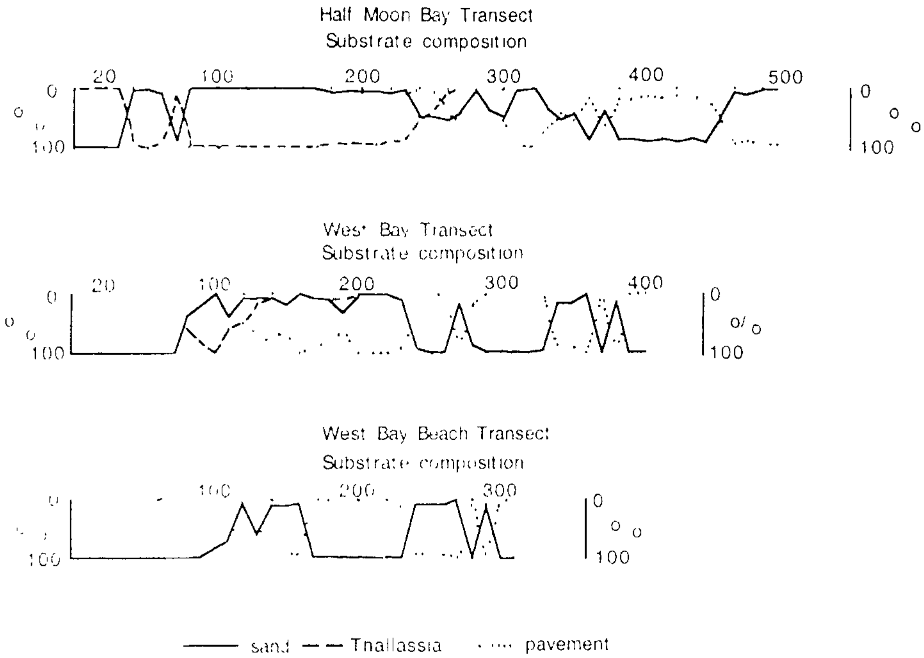


Figure 5. The distribution of substrate types across the three bathymetric profiles of Figure 3. The substrates within quadrants were described as either unconsolidated sediment, Thallassia, or live/dead coral pavement. Nearshore areas are all dominated by rippled sand. The lagoonal region of the Half Moon Bay transect is entirely Thallassia but West Bay and West Bay Beach are variable amounts of sand, Thallassia, and pavement (dead or live coral). The reef itself consists of patches of pavement and sand with Thallassia disappearing from the outer halves of these transects. The fringing nature of the reef at West Bay Beach precludes any Thallassia growth in the lagoon.

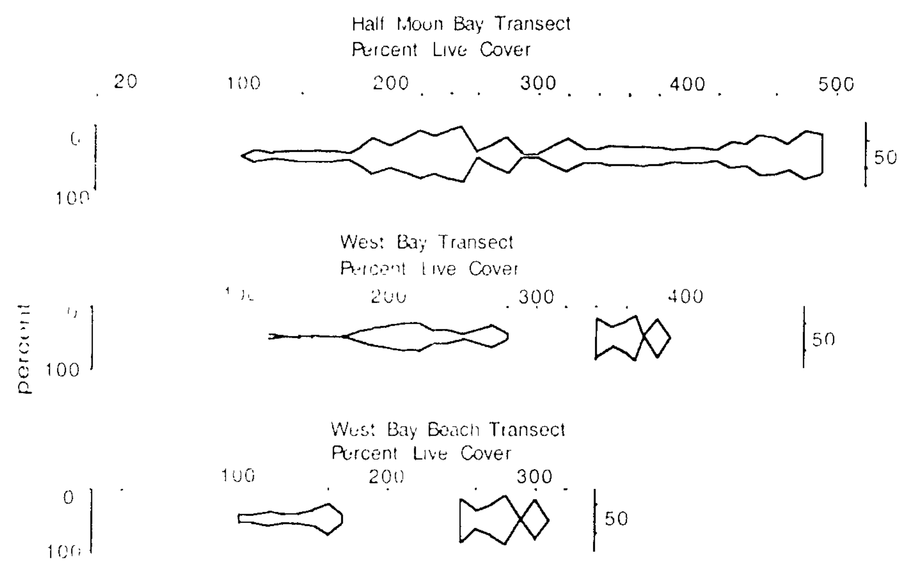
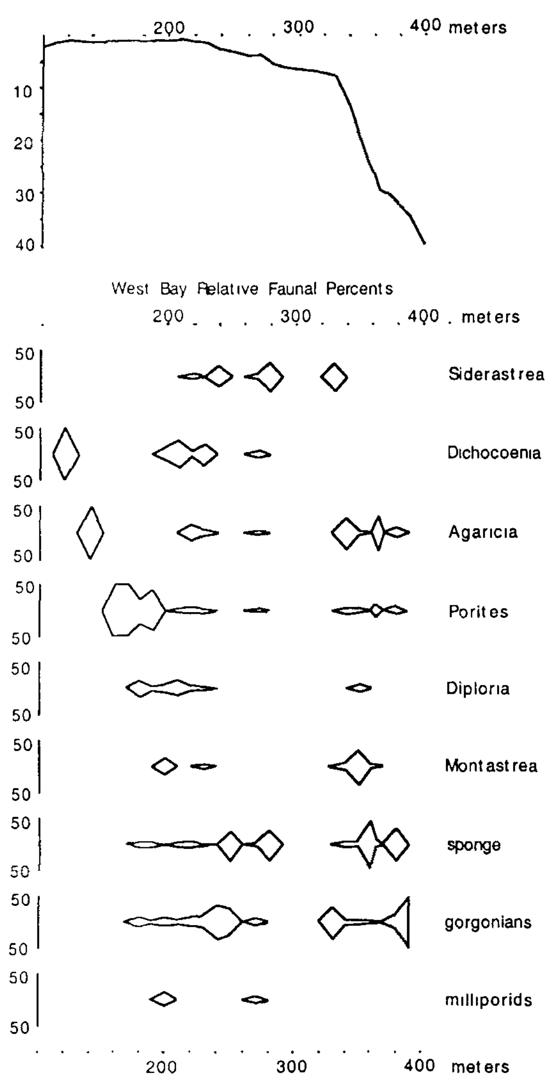


Figure 6. Quadrant counts along the three transects illustrated in Figure 3 were used to determine the abundance of live coral cover. Values were obtained by averaging the meter square quadrant estimates completed by two divers. Results are shown as a series of "cigar diagrams." The nearshore area (Zones 1-3), which in figure 2 was shown to be dominated by either rippled sand or Thallassia beds, lacks significant live coral. A sand moat (Zone 6) between 170 and 250 meters on West Bay Beach and 290 to 320 meters on West Bay is also reflected by the absence of live coral. Zones 4 and 5, the backreef and inner spur and groove are represented by variably high coral cover from 180 to 420 meters at Half Moon Bay; 170 to 290 meters at West Bay, and 100 to170 meters at West Bay Beach. The outermost portions of all transects show high coral cover of Zones 7 and 8, which subsequently drops on the fore reef terrace (Zone 9).



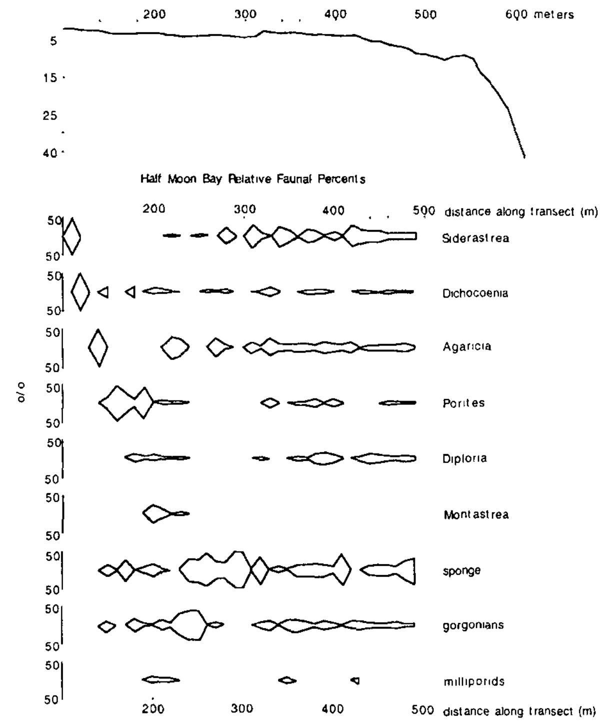


Figure 7 a and b. The relative percent of key coral and macrofauna across the West Bay and Half Moon Bay transects. The results were obtained by averaging the meter square quadrant counts by multiple divers. Trends in faunal composition and substrate type were used to identify the Zones shown in Table 1.

Relative Percentages

At the West Bay Beach and Half Moon Bay localities a square meter count was made of the number of individual coral colonies, hydrocoral, octocoral and sponges. This raw data was converted to percent of the total fauna. The percent abundance data is presented in two relative percentage vs. depth diagrams (Figs. 7a & b). These figures illustrate the distribution of the most abundant species only and is not a summary of all species present within the transect grids.

At both sites the inner lagoon macrofauna is dominated by Agaricia, Dichocoenia and Siderastrea. Faunal diversity increases across the back reef and reef crest regions whereas the fore reef is dominated by gorgonians and sponges. The decreased diversity associated with the sand moat (Zone 6) is clearly visible in both transects. The West Bay transect more clearly illustrates the general trend of low-high-low diversity from the lagoon to reef to fore-reef environments. For both the West Bay and Half Moon Bay transects, faunal diversity illustrated in Figure 7 shows a visual correlation with the general pattern in percent of live cover (Fig. 6).

Zones

Based on characteristic pavement type and distinct floral and faunal cover nine zones are recognized. Their characteristic features are summarized in Table 1. As the bathymetric profile of Figure 4 illustrates, all zones may not be present at all transects.

SEDIMENT STUDIES

Size and Composition

Sediment samples collected from the back reef and beach settings had different size attributes (Table 2). All reef samples were coarse to very coarse sand (0.83 phi to -0.3 phi) and all were poorly sorted (1.58-1.76 phi). Percent insoluble residue ranges from 1.84% to an anomalous high of 35% from a fringing reef adjacent to a steep drainage area (Fig. 3, locality

Table 1

ZONES

1. Nearshore rippled sand	Wave generated ripples with Calianassa burrows
2. Thalassia	Dense coverage of marine grasses and algae. Mollusks common
3. [illegible] pavement	Rock pavement with brown and red algae and an occasional coral or fan
4. Back reef	Increased coral diversity, variable ratios of live dead coral, A. palmata first found here. Diploria, Dichocoenia, P. asteroides, M annularis, Siderastrea and gorgonians are characteristic
5. Inner spur and groove	The back reef can be dissected by spur and groove structure which produces variable bathymetry and coral cover. A. palmata and A. cervicornis can be found, along with the coral genera of Zone 4. Agaricia spp. become very common
6. Outer sand moat	Barren to slightly bioturbated calcareous sand belt which abruptly ends against back of reef crest
7. Outer reef crest spur and groove	Variable bathymetry and coral cover, grooves may be floored by ripples
8. Fore reef wall	Steep gradient at the front of the reef characterized by significant increase in sponge fauna
9. Fore reef terrace	The sloping region at the base of the fore reef wall, characterized by patchy occurences of wall rubble hosting coral, gorgonians and sponges.

Table 2. Summary Table of Sediment Attributes.

	Summary Table of Sediment Attributes			
Locality	Mean (phi), verbal term	std dev (phi); verbal term	% insoluble	comment
West Bay	0 10 coarse sand	1 76, poorly sorted	3 39	back reef
Key Hole	(-)0.30, very coarse sand+	1 58, poorly sorted	34.99	fringing reef
Big Key	0 00, very coarse sand	1 60, poorly sorted	2.36	patch reef
Gibson's Bight	0 65, coarse sand	1 67 poorly sorted	3.8	back reef
Sandy Bay	(-)0.10, very coarse sand	1 76, poorly sorted	5.98	back reef
Palmetto Bay	0 00 very coarse sand	1 61 poorly sorted	2.11	back reef
Crawfish Bay	0 83, coarse sand	1 73, poorly sorted	1.84	back reef
	X = 0.17phi, coarse sand		X=8.77%	
Lighthouse Pt	(-)0.82, v coarse sand	0 69, moderately well sorted	93 65	beach
Half Moon	2 17, fine sand	1 08, poorly sorted	35.81	beach
Sandy Bay	2 15, fine sand	0 90, moderately sorted	93.83	beach
Turtling Bay	1 87, medium sand	1 70, poorly sorted	98.36	beach
Palmetto	2 58, fine sand	1 85, poorly sorted	88 51	beach
Hyatt	2 58, fine sand	2.19, poorly sorted	84.54	beach
Hurricane	(-)1.18, granule	0.75, moderately sorted	4 92	beach
Fantasy Island	1 40, medium sand	1.46, poorly sorted	1.77	beach
Crawfish Rock	2 82, fine sand	1 33, poorly sorted	96.88	beach
Paya Bay	1 99, medium sand	0 70, moderately sorted	19.33	beach
Camp Bay	0 38, coarse sand	1.56, poorly sorted	96 05	beach
	X=1.42phi, medium sand		X= 64%	

3). For the beach locales, grain sizes range from 2.82 phi (fine sand) to -0.82 (very coarse sand). Sorting values ranged from moderately well sorted (0.69 phi) to very poorly sorted (2.19 phi). As predicted, insoluble amounts were significantly higher, ranging from 1.77% up to 98%, with an average of 64%. Because of the low amounts of terrigenous material in the back reef samples, no further identifications of composition were made on these samples however the beach samples studied contained variable quartz:feldspar:lithic fragment ratios: Q29 F 29 L 41 to Q 93 F 7 with an average of Q 79 F 15 L 15. The insoluble size fraction finer than 3 phi was ground and slide mounted for X Ray diffraction. Results show that aluminosilicate clays are very rarely present, rather potassium feldspar, pargasite (an amphibole) and quartz were the dominant minerals. Because the intense weathering of metastable bedrock in a tropical climate should be conducive to chemical weathering and clay production, their absence from the sediment was not anticipated. We hypothesize that the fine-grained material was remaining in suspension across the lagoon and reef, and sediment traps were placed on the fore-reef to try and collect this material.

Suspended Sediment

In order to determine if fine-grained material was settling in the deeper water of the fore reef, 500ml water samples were taken at the three sites where sediment traps were placed (Fig. 3, localities 1a,1b and 1c). Water samples were subsequently filtered through 0.46 milli-micron pre-weighed filters, rinsed, dried and re-weighed. Results show that for the summer, suspended sediment ranged from 8 to 70 mg/l (n=11) and winter values ranged from 30 to 222mg/l (n=11). The summer values are in the range of those reported for Barbados by Tomascik and Sanders (1985) whereas the winter values are much higher.

Fore-Reef Sedimentation

In another effort to determine if fine-grained sediment was being deposited in the fore-reef, sediment traps were placed at the same sampling site for suspended sediment, and one additional locality (Fig. 3, locality 1d). Sediment traps were similar to those described by Aller and Dodge (1974) and consisted of 3 inch diameter clear plastic tubes mounted on a stand and held approximately 50 cm above the substrate. Two traps at each location were collected every week for a month. The contents were decanted into polythylene bottles. Water was filtered through 0.46 milli-micron pre-weighed filters, rinsed, dried and re-weighed. Silt and sand were retrieved and weighed. Results show that sedimentation rates in the summer range from a low of 0.14mg/cm^2/day to a high of 7.07 mg/cm^2/day (Table 3). Comparing values from the same site over a month of sampling (except for locality 1d, which was sampled for a one week period only) suggests a high degree of variability that shows no correlation to rainfall or wind events. Comparing the different sites to one another the values range from 1.65 mg/cm^2/day (locality 1b, n=7) to 2.31 mg/cm^2/day (locality 1a; n=8), which given the small sample size, we interpret as an insignificant difference. Sedimentation rates for the winter range from 41 mg/cm^2/day to 71 mg/cm^2/day. When compared to numerous published literature values from other reefs (see Rogers 1990) Roatan summer values are very typical of those cited in the literature by a variety of authors for other sites in the Caribbean (Table 3). Winter sedimentation values for Roatan are up to ten times that of summer rates, and those from Roatan are also among the highest reported in the literature. It is worth noting that most data summarized for other Caribbean localities in Table 3 are for shallower and more agitated reefal and lagoonal settings whereas the Roatan data comes from 20-30 meter depths on the fore-reef.

TABLE 3

ROATAN LOCALITY	AVERAGE SEDIMENTATION RATES summer	AVERAGE SEDIMENTATION RATES winter	Elsewhere in the Caribbean
locality 1d (El Alguila)	1 65 mg/cm2/day (n=7)	41.02 mg/cm2/day (n=2)	Barbados: 10-40 mg/cm2/day (Tomascki and Sanders, 1985)
locality 1a (Eel Garden)	2.31 mg/cm2/day (n=8)		Costa Rica: 30-60mg/cm2/day (Cortes and Risk, 1984)
Sandy Bay		71 33mg/cm2/day (n=2)	Puerto Rico: 2.5-2.6mg/cm2/day (Rogers, 1983)
			Jamaica: 0.5-1.1mg/cm2/day (Aller and Dodge, 1974)
			St. Thomas: 0.1-1.6mg/cm2/day (Rogers, 1982)

DISCUSSION

SEDIMENTATION EFFECTS ON CORAL

Sedimentation rates and total suspended solid values described in this study suggest that siltation may be a significant stressor on the Roatan reefs. The literature on the influence of sedimentation on reef development is extensive (see Rogers 1990 for an excellent review) and many studies suggest that along with water quality (nutrient loading) sediment loading on the reef may be the most important environmental stress. The effects include increased larval mortality (Babcock and Davies 1991), decreased light penetration (Telesnicki and Goldberg 1995; Rogers 1983), altered feeding behavior (Telesnicki and Goldberg 1995), stressed energy demands associated with increased cleansing (Aller and Dodge 1974; Dodge and Vaisnys 1977), reduced growth and calcification rates (Aller and Dodge 1974; Dodge and Vaisnys 1977; Rogers 1990), and a change in community structure (Loya 1976) or combinations of all of the above. Much current work focuses on "smoking gun" studies, i.e., exactly how increased sedimentation impedes coral respiration and photosynthesis (see, for example Telesnicki and Goldberg 1995), however geologists are still collecting data in order to determine how sedimentation may vary in and surrounding the reef. These studies can involve measurement of turbidity (see, for example Hodgson 1993), sedimentation rates (Hubbard 1986), resuspension rates (Aller and Dodge 1974; Cortes and Risk 1985) or runoff (Richmond 1993; MacIntyre, Cortes and Glynn 1993).

Existing studies which have documented the role of sedimentation stress on reef complexes, include Costa Rica (Hands, French and O'Neill 1993), Grand Cayman (Cortes and Risk 1985), Puerto Rico (Rogers 1983) and the Philippines (Hodgson 1993). Our study of Roatan has not only produced data on reef sedimentation for this portion of the Bay Islands reef tract, but will enable us to examine how these values will change over time in response to changes in adjacent land use accompanying increased development of the island. Values from both the suspended sediment and fore-reef sedimentation rates compared to those of other Caribbean reefs suggests that inhibition of coral as a result of water turbidity is a potential problem in Roatan and, with ongoing land use change, is likely to become even more so.

Larcombe and Wolfe (1999) and Larcombe, et al (1995) suggest that on the Great Barrier Reef, influx of terrigenous sediment is not a limiting factor for coral growth. Their conclusion is based on a correlation between near-bed suspended sediment concentrations (SSC) and oceanographic variables such as longshore drift, tidal currents, swell and wind-waves as well as the local geologic setting. These variables have kept levels of sediment accumulation constant despite increased anthropogenic influences. Their data also suggests that for a portion of the Great Barrier Reef, there is significant temporal and spatial variation in SSC that suggest synoptic studies are less valuable for presenting accurate pictures of sediment dynamics on the shelf and reef.

We agree with Larcombe and his co-workers (1999)on the desirability of long-term, continuous measurement, however the data presented in our study represents a first approximation of terrigenous sediment input and accumulation on Roatan. The relatively uniform bay (bight) and headlands topography of Roatan and absence of offshore islands presents a simple geologic setting relative to a more complex site, such as the Great Barrier Reef. We believe that our seasonal sampling intervals help capture some of the temporal variation in oceanographic and precipitation conditions. They also provide baseline data for monitoring sedimentation changes accompanying land use change. The impetus to this study was in part the result of observed changes in land use in Roatan, in particular clearcutting mangroves, dredging and beach replenishment and road and driveway construction which accompanies increased economic development on the island. This study suggests that siltation stress will continue to be a potential factor in reef degradation. Biologic monitoring of reef health is strongly recommended.

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