PALEOENVIRONMENTAL AND PALEOECOLOGICAL ANALYSES OF A PLEISTOCENE LAGOONAL, MOLLUSK-RICH FACIES, SAN SALVADOR ISLAND, BAHAMAS

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Numerous exposures of a Pleistocene mollusk-rich, lagoonal facies occur just south of the Bahamian Field Station on San Salvador Island. These outcrops surround a network of tidally-influenced saline lakes and blueholes (fig. 1). The facies is exposed as discontinuous lenses of poorly indurated, shelly rock. Twenty-four species of fossil mollusks have been identified. This facies contains two distinct molluscan associations. The most common association is dominated by two species of the burrowing bivalve *Codakia*. The other association is characterized by the carnivorous gastropods *Cerithium* and *Bulla* and the bivalve *Trigoniocardia* (Sterrer, 1986).

This Pleistocene facies represents a tidally-influenced lagoon of undetermined size similar to the modern south arm of Pigeon Creek Lagoon on San Salvador, which was studied for comparison. The shell assemblages found in this modern environment, which occur most commonly in current scour pits and in the main channel of the creek, contain many species identical to those identified in the fossil assemblages (Table 1). The fossil deposits resemble the thick, discontinuous deposits of shells found today in Pigeon Creek. Rocks of the Pleistocene deposits provide further evidence of an intertidal lagoon paleoenvironment. The *Codakia* association is found in a clean shelly marine sand of subtidal origin. This is equivalent to the subtidal channel in Pigeon Creek Lagoon. The *Cerithium-Bulla* assemblage, however, is present in a burrowed, muddy sand that contains a newly discovered trace fossil produced by *Upogebia* shrimp, that today burrow in the intertidal flats of Pigeon Creek Lagoon (fig. 2) (Noble et. al., 1991).

Direct correlations between the modern Pigeon Creek and the fossil assemblages reveal distinct relationships which provide valuable information for the paleoecologic and paleoenvironmental reconstruction of the Pleistocene facies, and also further develop the parameters which may strongly bias the interpretations of all paleoenvironments. There are striking similarities between the two study areas. The most abundant species found in the fossil assemblages, including the *Codakia* species, *Cerith*, and *Bulla*, are some of the most common species found in Pigeon Creek. The highly fossiliferous, discontinuous, lensoidal deposits in the Pleistocene facies are nearly identical in size, shape and density of shells to the modern molluscan accumulations in the scour pits and main channel of Pigeon Creek. Finally, the trace fossil in the Pleistocene facies, produced by burrowing activity of the shrimp *Upogebia*, is a significant paleoenvironmental indicator of the intertidal zone.

However, further comparisons between the modern and Pleistocene lagoonal facies reveal that there is a significant amount of difference. *Periglypta listeri*, which seems particularly susceptible to boring sponges, is underrepresented in the fossil record. *Divaricella quadrisulcata* and *Lucina pensylvanica* are entirely absent from the fossil record whereas they are common to abundant in the modern deposits of Pigeon Creek. In addition, several of the ark shells, *Noetia ponderosa* and *Anadara lienosa floridana*, are common in the fossil remains yet appear to be missing in the Pigeon Creek deposits.

The similarities between the modern and ancient study areas indicate that the Pleistocene molluscan assemblages were indeed deposited in a lagoonal facies. The differences between the two facies are equally as significant, but they do not dispute this interpretation. Rather, the differences illustrated by this study provide some parameters on the reliability of paleoenvironmental and paleoecologic reconstructions.

longshore current generated by waves (Davis, 1985). For such a southerly migration of sediment to have occurred on the lee side of the island, the dominant easterly winds and weather patterns could not have played a major role. Most likely, the forces that moved the sediment were those accompanying the northwesterly storms that periodically hit the island.

The sediment samples displayed a high degree of variance for all four statistical parameters, but only mean grain size and sorting will be considered here. The mean grain sizes ranged from 1.88 ø to -.12 ø (.24 mm to 1.1 mm). Using the Wentworth size classification scheme, these values range from fine sand to very coarse sand, with the vast majority of them falling into the coarse and medium sand classes. The second important statistical measurement is sorting, which is based on standard deviation. Of the fifty samples sieved, standard deviation values ranged from .88 ø to .29 ø. The corresponding verbal terms for these values are moderately to very well sorted. The majority of samples were well sorted. The mean grain sizes were plotted on a map and contoured (Figure 3). The map shows that the finer sediments are located in the northern half of the beach and the coarsest sediments are located south, both high up on the beach and below mean low water. The mean grain size distribution grades towards coarser as one moves south on the beach. Although not shown graphically here, the sorting of sediments also differed significantly by region. The poorest sorted samples were located on the northern half of the beach and the best sorting was found to the south. The presence of the largest and best sorted sediments on the southern half of the beach suggests that this is an area of highest wave energy, responsible for winnowing out the finer sediments. Conversely, the finer and more poorly sorted sediments found on the northern half would suggest low wave energies. These laboratory conclusions are compatible with observations made in the field.

In addition to the work done on the modern beach, some investigative work was done on the nearby Holocene cliffs to identify lithified beach facies. The rock face was searched for trace fossils which are often good indicators of paleoenvironments (Curran and White, 1986). Using the preferred burrow location of the modern day ghost crab for comparison, it is likely that fossilized ghost crab burrows would also have been located in a region extending from behind the swash zone to the rear of the backbeach. The rock stratigraphy also had regions with high spherical porosity, which is interpreted as fossilized bubble porosity. Previously documented in the the carbonate rock record, bubble porosity in the modern beach is found in the uppermost laminations of the accretion beds, near the berm (Inden and Moore, 1983). A third, mega-scale, facies indicator are large lithified cusps and horns, a topographic feature commonly found midway up the modern day beach. Finally, it is hypothesized that the upward fining stratigraphy of this outcrop is indicative of a sea level regression. The uppermost beds appear to be eolian, underlain by upper beach and berm deposits and the lowermost beds appear to be marine deposits. The sea level regression proposal is supported by the presence of fossilized clasts of beach rock in the outcrop, a feature that Inden and Moore (1983) argue to be a typical indicator of sea level regressions in rock stratigraphy.

CONCLUSION

A number of conclusions can be made from this study. (1) There was a net change in sediment distribution over the six month period from June to December, 1990. Figure 2 illustrates net erosion between stations 3 and 10 and deposition between stations 1 and 5. (2) Both mean grain size data and sediment sorting data indicate higher wave energy to the south and lower wave energy to the north. (3) The rock stratigraphy of the northern cliffs displays an upward fining sequence and many lithified features that are good indicators of specific beach facies. The addition of forthcoming thin section data, will aid in further delineating these facies.

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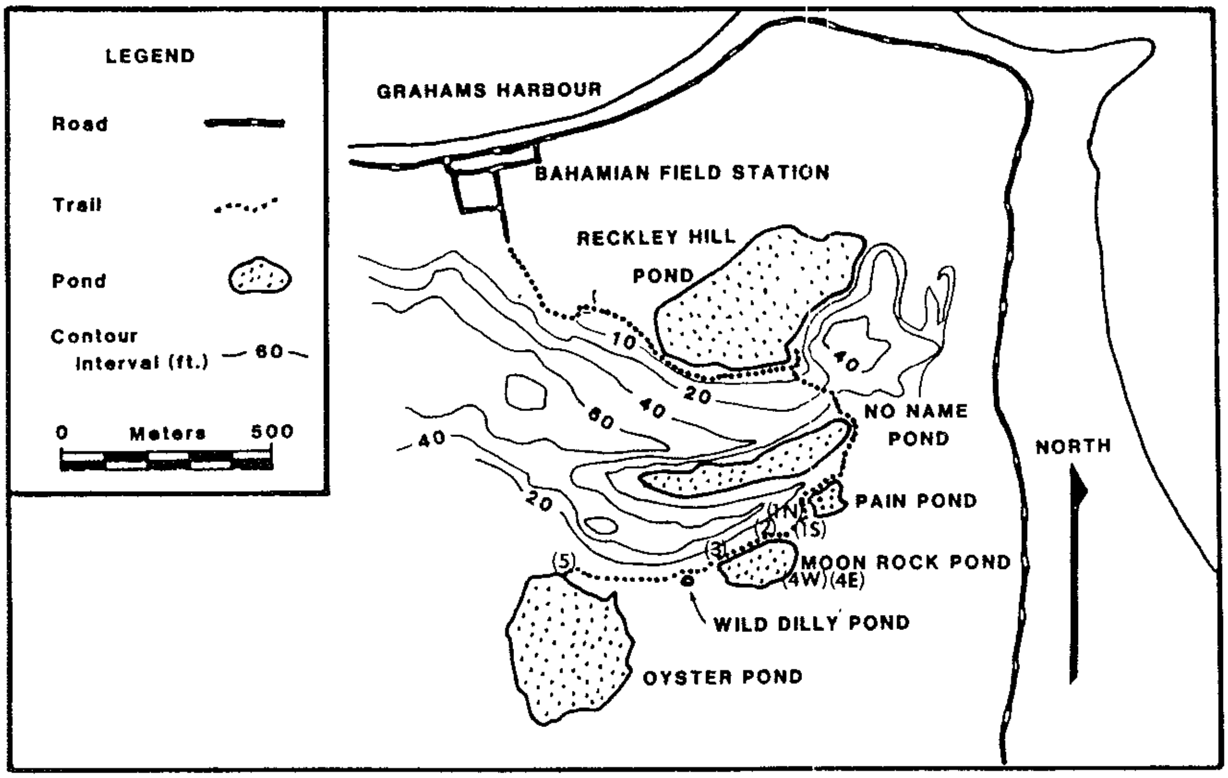

Figure 1. Tidally-influenced saline lakes and blueholes on San Salvador Island (Edwards, 1990). Collecting localities for the fossil molluscan assemblages are designated by the numbers in parentheses.

TABLE 1.

Complete Faunal Listings

Fossil Assemblages	Modern Pigeon Creek
Bivalves	**Bivalves**
1. *Anadara lienosa floridana*	*Anomalocardia brasilia*
2. *Anodontia alba*	*Chione cancellata*
4. *Chione cancellata*	*Codakia orbicularis*
5. *Chione paphia*	*Codakia orbiculata*
6. *Codakia orbicularis*	*Divaricella quadrisulcata*
7. *Codakia orbiculata*	*Glycymeris pectinata*
8. *Lucina floridana*	*Lucina pensylvanica*
9. *Macoma hendersoni*	*Periglypta listeri*
10. *Noetia ponderosa*	*Semele nuculoides*
11. *Periglypta listeri*	*Tellina* sp.
12. *Pitar albida*	*Trigoniocardia antillarum*
13. *Tellina alternata*	
14. *Tellina angulosa*	**Gastropods**
15. *Trigoniocardia antillarum*	*Acmaea testudinalis*
	Anachis sparsa
	Astraea phoebia
Gastropods	*Bailya parva*
16. *Astraea phoebia*	*Bulla occidentalis / striata*
17. *Bulla occidentalis*	*Cerithidea scalariformis*
18. *Cerithium algicola*	*Cerithium algicola / eburneum*
19. *Columbella mercatoria*	*Cerithium literatum*
20. *Modulus carchedonius*	*Cerithium variable*
21. *Murex recurvirostris rubidus*	*Columbella mercatoria*
22. *Nerita tessellata*	*Conus* sp.
23. *Strombus gigas*	*Diodora listeri*
24. *Tegula fasciata*	*Modulus carchedonius*
	Nassarius albus
	Nerita tessellata
	Olivella floralia
	Polinices lacteus
	Smaragdia viridemaris
	Strombus gigas
	Tegula fasciata
	Tricolia affinis
	Turbo castaneus
	Vermicularia spirata
	Oyster
	Pinctade radiata
	Scaphopod
	Dentalium occidentale

Table 1. A complete faunal listing of both the Pleistocene facies as compiled by this study, and of the modern Pigeon Creek Lagoon as compiled by this study and Slone and Boardman (1990). Species of the Pleistocene facies have been numbered to correspond with figure 2.

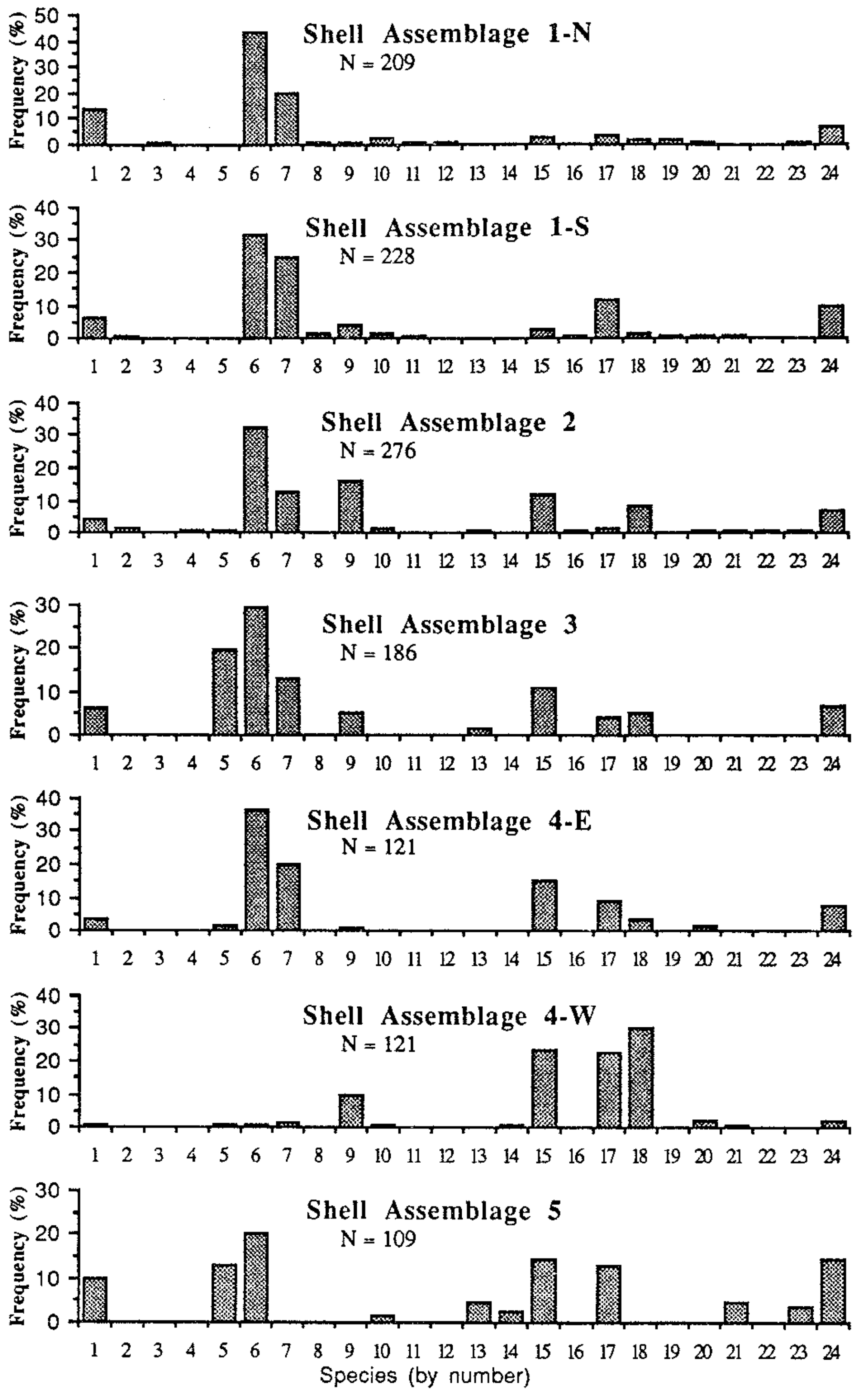

Figure 2. Histograms illustrating frequency of each species in each fossil assemblage. Species are listed by the numbers assigned in Table 1.

PETROGRAPHY AND PALEOENVIRONMENTS OF MARINE LIMESTONES
NORTHERN INTERIOR, SAN SALVADOR ISLAND, BAHAMAS

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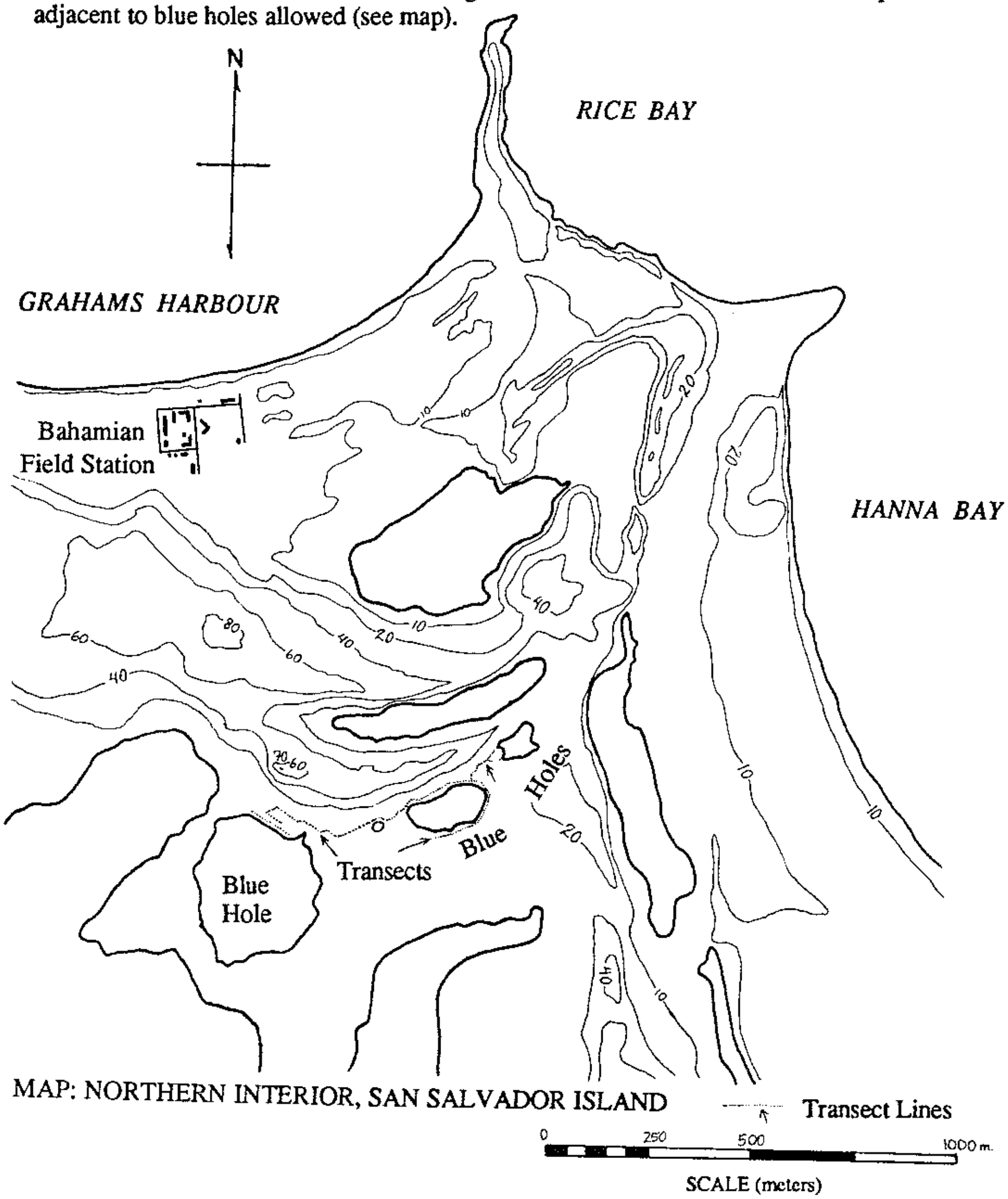
INTRODUCTION

Though the coastal areas of San Salvador Island have been much studied by geologists, the interior has received less attention. While cutting a path to study the ecology of several blue holes in the interior, southeast of the Bahamian Field Station, researchers discovered several fossil-bearing outcrops. Fossils initially noticed included large bivalve and Strombus shells. The present study was designed to investigate these rocks and to determine their petrography and paleoenvironment. Because of the constraints of dense vegetation, the study transects generally dog-leg along the path, passing four blue holes in a roughly linear stretch. Other transects were studied along offshoots from the main trail as minor paths and clear areas adjacent to blue holes allowed (see map).



MAP: NORTHERN INTERIOR, SAN SALVADOR ISLAND