Reef coral diversity in the Late Maastrichtian of Jamaica

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Abstract: The Jamaican Cretaceous succession includes rich assemblages of fossil macroinvertebrates that date from the latest Maastrichtian. Reef corals are an important component of these assemblages and are found in abundance in many of the 27 Cretaceous inliers across Jamaica. In the present work, we have analysed results from detailed sampling of three of these inliers (Central, Marchmont and Maldon) to make estimates of coral species richness and diversity immediately prior to the K-T boundary.

From more than 1350 identified scleractinian and octocoral specimens from 47 sample sites, a total of 58 species from 39 genera were recognized. Bulk collections (441 specimens) from a single ~1m thick bed in the Guinea Corn Formation of the Central Inlier yielded 35 species from 28 genera. An analysis of sampling using jack knife estimates of species richness and locality-sampling curves suggests that this data gives a reasonably accurate estimate of richness in the Jamaican terminal Cretaceous.

Taxonomic richness of this Maastrichtian assemblage is high relative to known faunas from the Caribbean Cenozoic. Richness in the extensively sampled unit in the Guinea Corn Formation is also comparable to that in similarly well-sampled units in the Cenozoic of Jamaica. This data stands in stark contrast to the species-poor Caribbean faunas of the Paleocene through Early Eocene.

Key words: Reefs, corals, Maastrichtian, K-T, Caribbean, Jamaica

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1. INTRODUCTION

Studies of reef coral faunal change across the Cretaceous-Tertiary transition have been hampered by the lack of well-sampled late Maastrichtian coral assemblages. Surveys of coral occurrences at large geologic and geographic scales have produced interesting results concerning large-scale patterns (e.g. ROSEN & TURNŠEK, 1989) but these studies are not detailed enough to approach questions concerning the timing and rate of possible coral taxonomic turnover at the K-T boundary. Indeed, the well-dated and well-described faunas from the Latest Maastrichtian that are necessary for such studies are essentially unknown in most regions, especially the Caribbean. Recent work on Jamaican Cretaceous strata (STEUBER, et al., 2002), however, indicates that these successions preserve diverse shallow water macroinvertebrate communities from the terminal Maastrichtian (66.7–65.8 ma). This provides an ideal opportunity to examine Caribbean reef coral diversity and palaeoecology immediately preceding the K-T transition and to make inferences concerning the effects of the K-T boundary event.

The present study is a first step in analysing reef coral richness and diversity in the Jamaican uppermost Cretaceous and is an outgrowth of a significant volume of recent geologic mapping and biostratigraphic research on the uppermost Cretaceous strata in Jamaica (GUNTER et al., 2002; GUNTER & MITCHELL, 2005; MITCHELL, 1999; 2002a; 2002b; 2004; and others). We here present a brief documentation of the fauna based on very large collections from well-dated material. Because sample size can be a major factor in determining observed taxonomic richness (JOHNSON, 2001 and references therein), we make a detailed analysis of the adequacy of the extent and strategy of our sampling. We also attempt to place the observed taxonomic richness and ecologic diversity in the Late Maastrichtian of Jamaica in a broader context by making comparisons with data from the Caribbean Cenozoic coral record (BUDD, 2000). Finally, we compare a single well-sampled site from our Late Cretaceous localities with richness and diversity data from similarly sampled sites from the Late Oligocene of Jamaica.

1.1. Geology of the Jamaican Cretaceous

At roughly 11,000 km², Jamaica is the fourth largest of the Greater Antillean Islands. Its general geology consists of a series of four blocks separated by fault bounded belt structures trending E-W and NW-SE across the island (ROBINSON, 1994). The blocks consist of a structurally complex Cretaceous aged basement capped by a less deformed cover of Cenozoic sediments. These Cretaceous rocks are exposed across Jamaica (Fig. 1) in a series of 27 inliers (ROBINSON, 1994). In central and western Jamaica the Cretaceous

rocks chiefly include volcanics, coarse to fine grained volcaniclastic sedimentary rocks and impure marly limestones (ROBINSON, 1994; MITCHELL, 2004). It is these limestones and finer gained clastic sedimentary rocks that often yield rich faunas of Maastrichtian marine macrofossils (see MITCHELL, 2002b for literature review).

Traditionally it has been difficult to make detailed correlations between the various inliers and in turn to correlate these Cretaceous rocks with successions outside Jamaica. The rudist genus, *Titanosarcolites*, has been used as a marker for the Maastrichtian in Jamaican shallow water marine units (Fig. 1) but recent studies have been able to improve some of the lithostratigraphic (MITCHELL & BLISSETT, 2001) and biostratigraphic links (e.g. GUNTER et al., 2002) within Jamaica and with other areas. Additionally, STEUBER et al. (2002) examined Sr isotopic ratios from pristine rudist bivalve shells from four different Jamaican Cretaceous inliers. This study produced consistent results that show dates for marine units in the Central Inlier, Marchmont Inlier, and Maldon Inlier all within 1 million to at most 1.5 million years of the K-T boundary (STEUBER et al., 2002). These dates are all consistent with lithostratigraphic relationships (MITCHELL, 1999; MITCHELL & BLISSETT, 2001) as well as recent biostratigraphic work (MITCHELL & GUNTER, 2002).

1.2. Jamaican Cretaceous Corals

Cretaceous corals in Jamaica have received considerable taxonomic treatment in the past compared to material from other parts of the Jamaican stratigraphic column (DUNCAN & WALL, 1865; VAUGHAN, 1899; WELLS, 1934, 1935). This is probably a consequence of the ease of collection and the generally good preservation that drove early collector's efforts toward the marly limestones of the Jamaican Cretaceous and away from the largely mouldic fossils in the pure limestones (STEMANN, 2004) that make up most of the Jamaica's Cenozoic cover.
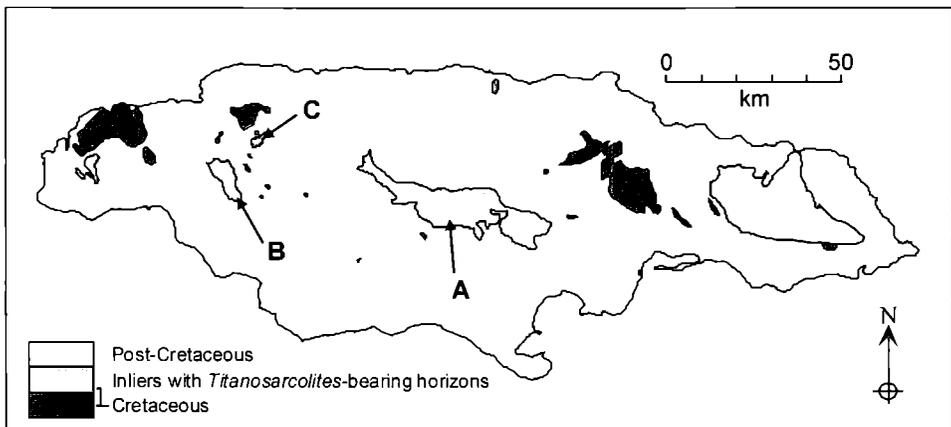

Fig. 1: Simplified geologic map of Jamaica showing positions of Cretaceous Inliers in Jamaica (after MITCHELL & GUNTER, 2002). Inliers with limestones containing the Maastrichtian age rudist bivalve, *Titanosarcolites*, are shown. Labelled inliers sampled in this study are as follows, **A**- Central Inlier, **B**- Marchmont Inlier, **C**- Maldon Inlier.

A number of species have been named from the Jamaican Cretaceous from surprisingly little collected material. There is, however, some controversy concerning the age of much of the type material described as coming from the Jamaican Cretaceous. Material from eastern or far western Jamaica (WELLS, 1935) may not be easily correlated with the Latest Maastrichtian successions elsewhere. Also, both VAUGHAN (1899) and WELLS (1934) express concerns that a number of putative Cretaceous holotype specimens may have been collected from the Eocene Yellow Limestone Group. The Jamaican Yellow Limestone Group is a unit of Early-Middle Eocene age with occasional, scattered scleractinian corals (STEMANN, 2004). It is often in close proximity to Cretaceous age rocks in several inliers across Jamaica (ROBINSON, 1994). Indeed, the area around Catadupa, St. James Parish, Jamaica, the type locality for 12 species of Cretaceous corals (VAUGHAN, 1899; WELLS, 1934), is structurally complex and contains a range of coral bearing Cretaceous and Eocene aged units (E. Robinson, personal communication). Additionally, some corals reported from the Yellow Limestone elsewhere in Jamaica are of doubtful provenance and may actually come from Cretaceous units (see WELLS, 1935 in his description of *Cyclolites thomasi*).

Added to these stratigraphic uncertainties is the fact that some holotypes and figured specimens from VAUGHAN's (1899) taxonomic work were apparently lost in the 1907 earthquake in Kingston. Chief among these is holotype for the type species of the genus *Stiboriopsis*, *S. jamaicaensis* VAUGHAN, 1899. The sum total then suggests that the present record of species from the Jamaican Cretaceous is inadequate and considerably more detailed collecting and taxonomic work is clearly required.

Compared to their taxonomy, the palaeoecology of Jamaica Maastrichtian coral communities is perhaps better known (COATES, 1977; LIDDELL et al., 1984; MITCHELL, 2002a, 2002b). COATES (1977) and MITCHELL (2002b) have produced detailed studies of coral associations in the Guinea Corn Formation of the Central Inlier. These works qualitatively looked at coral abundance and diversity patterns and noted the existence of distinctive circumrotary corals in this unit (MITCHELL, 2002b). Both COATES (1977) and MITCHELL (2002) recognize distinct assemblages of corals in the Guinea Corn Formation, probably reflecting differing conditions of substrate and turbidity during deposition of this unit (MITCHELL, 2002b).

2. STUDY AREA

The field collection aspect of this study concentrated on the Central Inlier and in the western Jamaica on the Marchmont and Maldon Inliers (Fig. 1). These three areas contain well dated latest Maastrichtian sediments (see above) and have been the focus of considerable recent geological investigations (e.g. GUNTER & MITCHELL, 2005; MITCHELL, 2004).

2.1. The Central Inlier

The Central Inlier contains a large (~300 km²) exposure of Cretaceous rocks located in the centre of what has been termed the Clarendon Block (ROBINSON, 1994). These rocks

range in age from ?Turonian through Maastrichtian (MITCHELL, 2004) and represent an ancient volcanic island arc system (ROBINSON, 1994 and references therein). It is chiefly made up of thick successions of altered volcanics and volcaniclastics basally and less altered mixed terrestrial and marine clastics and carbonates. These are in turn overlain by more ?latest Maastrichtian – Paleocene volcanics (MITCHELL & BLISSET, 2001; MITCHELL, 2004). Much of the marine portion of this succession has been termed the Guinea Corn Formation, a 165–200 m thick unit comprised of bedded rudist and coral bearing lime-stones, mudrocks and sandstones (WOODLEY & ROBINSON, 1977; MITCHELL, 1999). The Guinea Corn Formation is widely exposed in the Rio Minho valley and its Central Inlier tributaries, such as the Slippery Rock River (MITCHELL, 2002b).

2.2. The Marchmont and Maldon Inliers

The Marchmont and Maldon Inliers lie to the west of the Central Inlier at the edge of the Clarendon Block (Fig. 1). Unlike the Central Inlier, these two smaller western inliers do not expose extensive sequences of altered volcanic rocks (ROBINSON, 1994; GUNTER & MITCHELL, 2005). Both the Marchmont and Maldon Inliers contain far less volcanic rocks and coarse volcaniclastic sediments. Because both these inliers expose rocks that were deposited at some distance from the active Maastrichtian volcanic centres to the east (MITCHELL, 2004), they generally contain more finer grained sand/siltstones, mudrocks and limestones than does the Central Inlier (ROBINSON, 1994; GUNTER & MITCHELL, 2005). Several mappable Uppermost Cretaceous carbonate and fine grained clastic units can be distinguished in the Marchmont and especially the Maldon Inliers (GUNTER & MITCH-ELL, 2005).

As in the Central Inlier, the limestones and mudrocks contain abundant marine fos-sils including abundant branched and massive colonial corals as well as solitary forms. Rudists (*Titanosarcolites* and others) have been described in detail (see GUNTER & MITCH-ELL, 2005; MITCHELL, 2003 and references therein). Outcrops with extensive, continuous sections are not as common as in the Central Inlier, but there are scattered hillside ex-posures that yield rich fossil faunas.

3. MATERIAL

Material was examined from 47 sample sites in the Central, Marchmont and Maldon Inliers. Most samples were taken from beds tied to measured sections (GUNTER & MITCH-ELL, 2005; MITCHELL, 1999; MITCHELL & BLISSETT, 2001). Attempts were made at each local-ity to collect as many forms as possible. For the Marchmont and Maldon Inliers, we also examined additional well located collections made by former University of the West Indies geological mapping students and the Jamaican Geological Survey Bureau. All material is now part of the collections of the University of the West Indies Geology Museum (UWIGM).

In our analysis of sampling, 13 of the 47 sample collections were combined with other stratigraphically adjacent samples to give a total of 34 sampled localities. This helped to maintain a statistically significant number of specimens per locality (a mean

Acrosmillia sanchez-roigi (WELLS, 1941)
Actinacis A
Actinacis B
Actinacis C
Actinacis D
Actinacis E
Actinastrea A
Rhabdophyllia quaylei WELLS, 1934
Calamophylliopsis B
Centrastrea hilli WELLS, 1934
Cyathophora A
Cyathoseris A
Cyathoseris B
Dasmiopsis A
Dendrogyra A
Dichocoenia B
Dichocoenia C
Dichocoenia trechmanni WELLS, 1934
Dimorphoseris A
Diplaraea boltonae WELLS, 1934
Epistreptophyllum A
?Favia A
Goniopora reussiana (DUNCAN in DUNCAN &
    WALL, 1865)
Goniopora trechmanni (WELLS, 1934)
Haplarea C
Leptophyllarea B
Leptoria (Dictuophyllia) conferticostata
    (VAUGHAN, 1899)
Meandrarea clarendonensis WELLS, 1935
Mesomorpha catadupensis VAUGHAN, 1899

?Microphyllia A
Microsolena A
Microsolena B
Montastraea A
Montastraea B
Montastraea D
Montastraea schindewolfi (WELLS, 1934)
Multicolumnastrea cyathiformis VAUGHAN,
    1899
Mycetophylliopsis A
?Nefophyllia A
Orbignygyra A
Ovalastrea anomalos (WELLS, 1934)
Pachygyra A
Pachygyra B
Paracycloseris B
Paracycloseris C
Paracycloseris elizabethae WELLS, 1934
Phyllosmilia A
Placosmilia A
Strotogyra A
Strotogyra C
Synastrea A
Synastrea adkinsi WELLS, 1934
Trocharaea A
Trochoseris catadupensis VAUGHAN, 1899
Trochosmilia hilli VAUGHAN, 1899

Polytremacis A
Polytremacis B
Polytremacis C

Tab. 1: List of coral species identified in samples from the Central, Marchmont and Maldon inliers.
Species are listed alphabetically with Octocorallia listed after the Scleractinia. Generic
placement of three forms is doubtful and these are denoted with a '?' before the ge-
neric name. Species not yet described are left in open nomenclature and designated with
a letter following the generic name.

of 40 specimens per locality, median 20 per locality). Twenty (20) of these localities are
in the Central Inlier, 6 are from the Marchmont and 8 from the Maldon Inlier.

One especially rich site in the Central Inlier, the Main Coral Bed (MCB) of the
Guinea Corn Formation was collected in special detail. This 0.8 to 1.0 m thick bed ex-
posed along the Rio Minho is a marl-rich biostrome that likely represents a coral
thicket. It contains a rich fauna of in situ or slightly toppled colonial and solitary corals,
including abundant Actinacis spp., Dichocoenia trechmanni, Calamophylliopsis sp. and
Trochoseris catadupensis. It has been collected extensively since 1997, including ap-
proximately 30 kg of bulk samples.

Coral material was separated from all locality collections and identified to species level. Small (<1.5 cm in diameter) solitary corals as well as small dendroid-phaceloid colonies are relatively common through out the uppermost Cretaceous of Jamaica. With detailed collecting, these diminutive fossils, including an important new species and genus of Turbinoliidae (Stephen Cairns personal communication), can be found at localities in all the Cretaceous inliers examined in Jamaica. However, these smaller corals are clearly under-represented in most museum collections chiefly because of their size and inconspicuous nature in outcrop. Small solitary and colonial corals also are not as common in units that appear to represent purer carbonate shoal or near "reefal" facies. Therefore, in order to compare Cretaceous coral faunas with documented Cenozoic reef coral assemblages, the present study concentrated only on larger solitary and colonial "reef corals" while solitary corals, and phaceloid and dendroid colonies with diameters consistently less than 1 cm were left out of our analysis. We use the term "reef corals" here in a general way and do not wish to imply any certainty about whether these are zooxanthellate or azooxanthellate corals. Work on smaller solitary and colonial corals from the Late Cretaceous of Jamaica will be presented in future reports.

In the present work, a total of 1377 specimens of these fossil corals were identified to species level. In the Main Coral Bed (MCB) 441 specimens were identified. These were included in both a raw abundance matrix of species and localities as well as a presence/absence species locality matrix.

4. RESULTS

A total of 55 scleractinian species and 3 stony octocoral species were identified in our collections (Tab. 1). These are here placed in 39 different genera including the octocoral *Polytremacis*. Most of the genera recognized are typical of Cretaceous faunas from
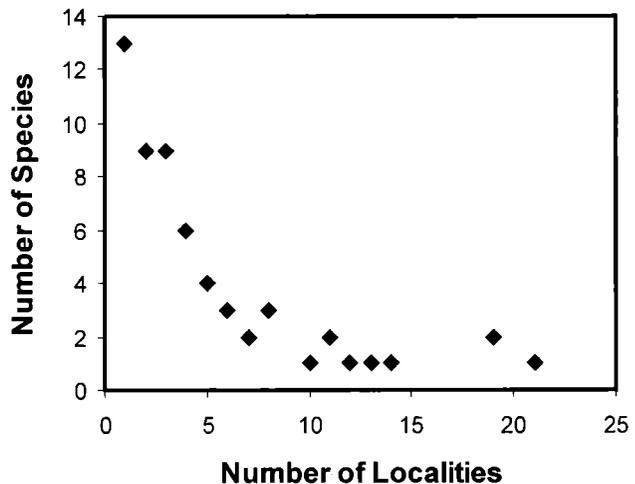

Fig. 2:
Graph depicting the number of localities per species for the Jamaican Late Cretaceous coral fauna. Note that more than half of the 58 species identified are found in only 1–3 localities. Three species are found in more than 18 localities.

North America (e.g. BARON-SZABO & GONZÁLEZ-LEÓN, 1999) or from the Tethyan region (e.g. ABDEL-GAWAD & GAMEIL, 1995; TURNŠEK, 1997). Only 16 of these species have been previously described from Jamaica (DUNCAN in DUNCAN & WALL, 1865; VAUGHAN, 1899; WELLS, 1934, 1935). One species, *Acrosmillia sanchez-roigi* (WELLS, 1941) has been previously been identified only in the Upper Cretaceous of Cuba. Eight of the species previously identified from the Jamaican Cretaceous (VAUGHAN, 1899; WELLS, 1934, 1935) were not found in our collections.

Examination of the number of localities where each species is present (Fig. 2) reveals that the 3 most common species in our collections, *Multicolumnastrea cyathiformis*, *Dichocoenia trechmanni* and *Goniopora trechmanni*, were found in 18 or more of our 34 localities. All other species are present in 14 localities or less. More than half of the fauna (31 of 58 species) was found in collections from only 1–3 localities. This suggests that with more intensive sampling many of these rarer species could be found to be more widespread than our present data indicates.

Across all localities, a wide array of growth forms was found (Fig. 3). Most species possess a massive-columnar growth form, but a large proportion of the fauna is also ramose or phaceloid. Only plate-shaped explanate growth forms appear under represented.

4.1. Sampling

We analysed the adequacy of our sampling using species area curves in the program PC-ORD version 2.1 (McCUNE & MEFFORD, 1995). This procedure makes repeated subsets
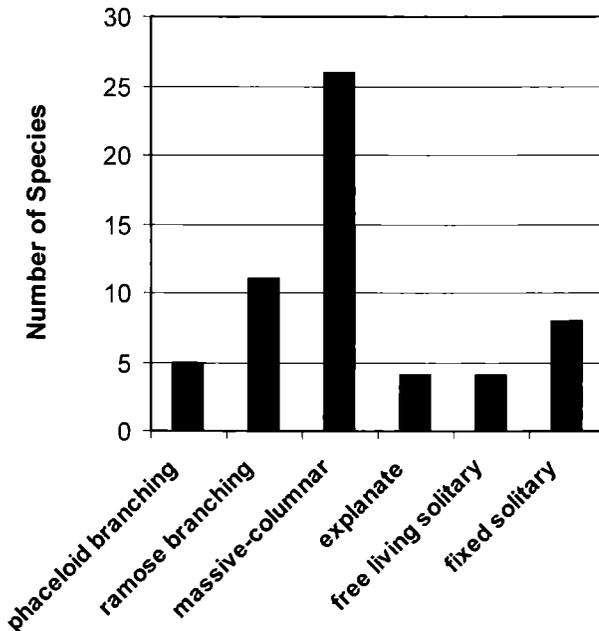

Fig. 3:
Bar chart displaying diversity of growth forms in sampled Jamaica coral fauna. Number of species with predominantly phaceloid, ramose, massive-columnar, explanate, free and fixed solitary growth forms shown. Total number of species of scleractinian corals and octocorals = 58.

of the original presence/absence species versus locality matrix and determines the average number of species in each subsample. The result is a species area curve that can graphically be used to determine how well sampling is capturing real taxonomic richness. If an adequate number of localities have been sampled, the curve will reach a stable level at the maximum number of species in the data set (MCCUNE & MEFFORD, 1995). We also calculated a first order jack knife estimate of true species richness (PALMER, 1990) in our total data set and in the Central and combined Marchmont and Maldon Inliers.

The species area curve for all our Late Maastrichtian localities (Fig. 4) appears to begin to level off as it approaches the level of total observed species richness (58). This suggests that we have approached an adequate number of samples, however, jack knife estimates give a species richness of 70–71 species or roughly 20% greater than observed.

Species area curves for the Central Inlier and the combined western inliers (Fig. 5) each show curves that are clearly not levelling off. First order jack knife estimates of richness in the Central Inlier (52.3) and combined Marchmont and Maldon Inliers (61.9) suggests that less than 70% of the true richness has been observed in each of these groups of localities. The combined western inliers, with numerous species found in only 1 or 2 localities, appear to be most in need of additional sampling.

4.2. The main coral bed

A total of 35 species from 441 specimens were identified in the collections from MCB, the highest number of species for any of our localities. Fourteen of these species were present in the MCB sample in numbers of no more than 3 specimens. Thirty or more
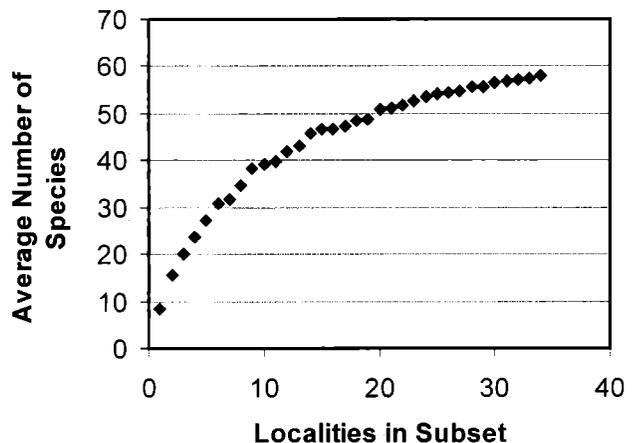
All Maastrichtian Samples

Fig. 4:
Species area curve showing sampling efficiency for all 34 Late Maastrichtian localities. Points represent average species occurring in randomized subsets of original locality data.

specimens were found for 4 of the species, *Actinacis* A, *Placosmilia* A, *Strotogyra* A and *Dichocoenia trechmanni* WELLS. The ramose branching coral *Actinacis* A was most abundant with 110 specimens identified. Coral diversity indices calculated for the MCB are Shannon Wiener (base 10) H= 1.230, Evenness = 0.797, Simpson's Diversity Index = 0.899.
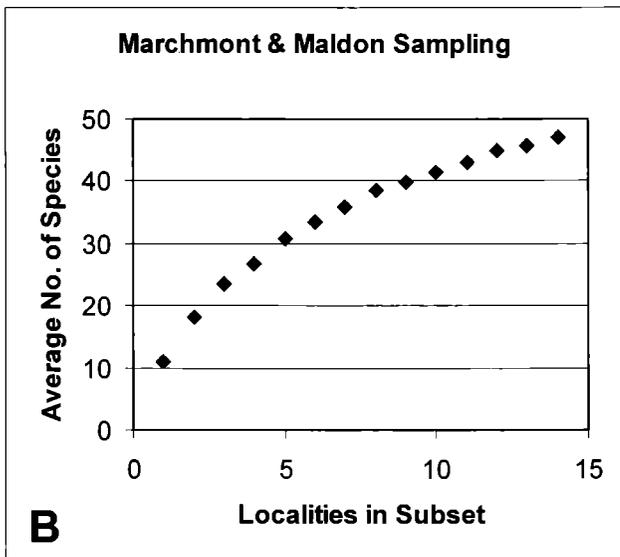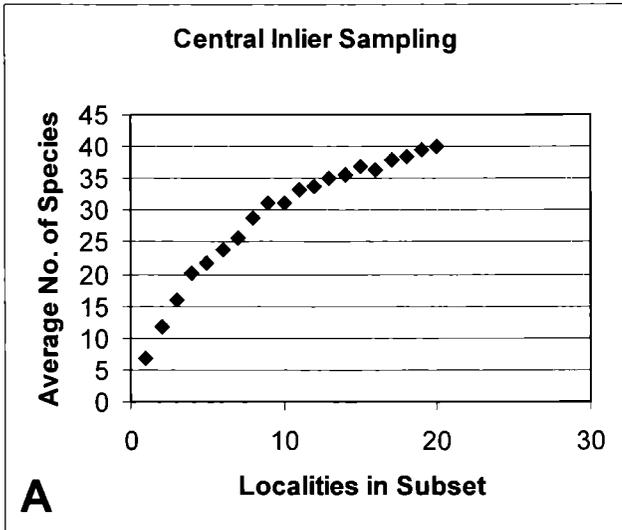

Fig. 5:
Species area curves for Central Inlier localities (A) and for combined Marchmont and Maldon Inlier localities (B). Note that neither curve levels off suggesting that more sampling in each inlier will yield more species.

5. DISCUSSION

To get an idea of the relative magnitude of the observed and estimated richness for the latest Maastrichtian age coral fauna of Jamaica, we compared our results with published accounts of taxonomic richness from the Cenozoic of the Caribbean. BUDD (2000) presents data on generic and species richness for 57 well-documented coral-bearing lithostratigraphic units in the Caribbean from the Eocene through the Recent. We have added data from 5 formations of the Middle Eocene – Middle Miocene White Limestone Group of Jamaica (STEMANN, 2004). While the quality of this data is variable in terms of equivalence in sampling area and collection effort, the range of richness values do provide a baseline estimate of what is "normal", "high" or "low" richness in the Cenozoic. It should be noted, however, that these per unit richness values are all lower than total observed richness in the Caribbean during the time that unit was deposited.

The Caribbean Cenozoic generic richness records range from 3 to 34 with a mean of 16.6 and a median value of 12 (Fig. 6). Species richness for Caribbean Cenozoic units ranges from 5 to 74 with a mean of 26.8 and a median value of 20.

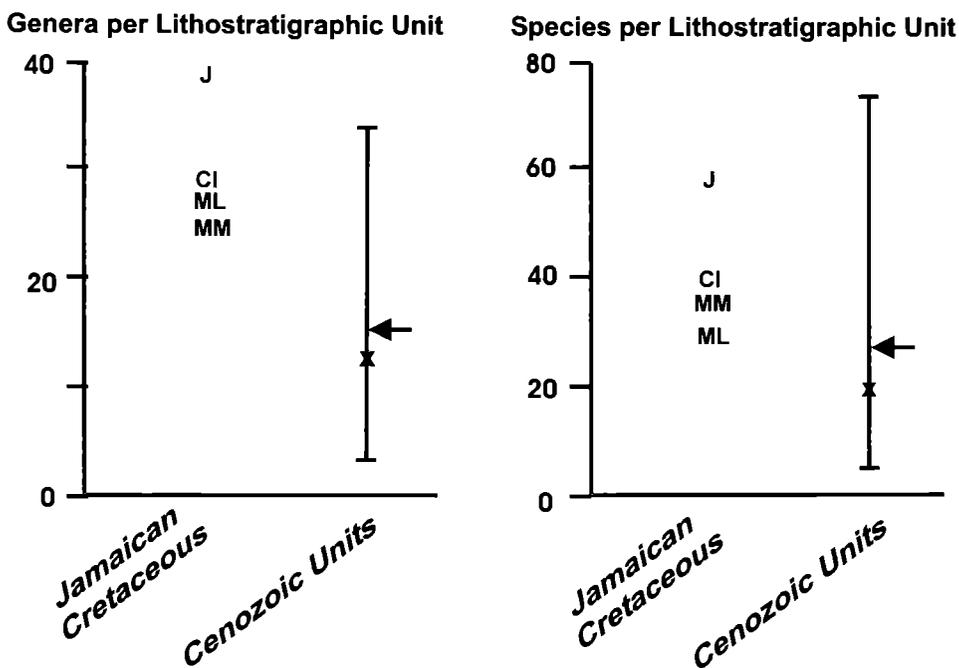**Genera per Lithostratigraphic Unit**   **Species per Lithostratigraphic Unit**

Fig. 6:   Generic and species richness comparison between Jamaican Late Maastrichtian units and the record from the Caribbean Cenozoic. Cretaceous data given for Central Inlier (CI), Maldon Inlier (ML), Marchmont Inlier (**MM**), and all of Jamaica (J). Range of richness data for 62 Cenozoic units given along with median value (**X**) and mean (arrow). Data for Cenozoic records from BUDD (2000) and STEMANN (2004); see text for explanation.

In comparison, taxonomic richness for each Late Cretaceous inlier sample is quite high. Richness for each inlier is higher than mean or median values for the Cenozoic records. For the total Late Maastrichtian data generic richness is beyond the range of Cenozoic values and species richness is greater than 90% of all Cenozoic units recorded. Generic richness values for each individual Cretaceous inlier were again higher than 90% of the Cenozoic records. Species richness values were greater than approximately 70% of the recorded faunas from the Caribbean Cenozoic.

We compared richness and diversity in the MCB with data from 4 extensively sampled coral patches and thickets from the Late Oligocene Moneague Formation of Ja-

Main Coral Bed

A

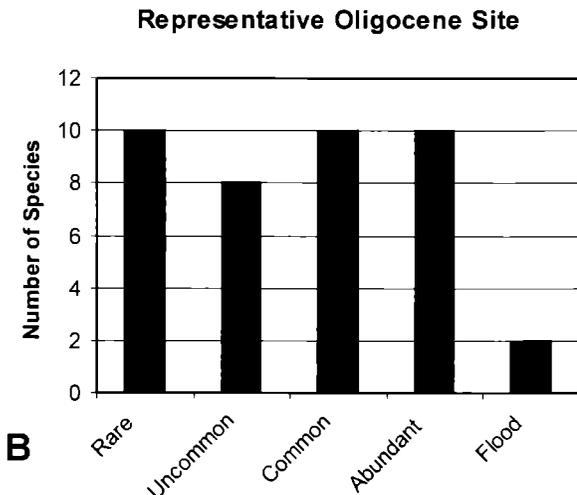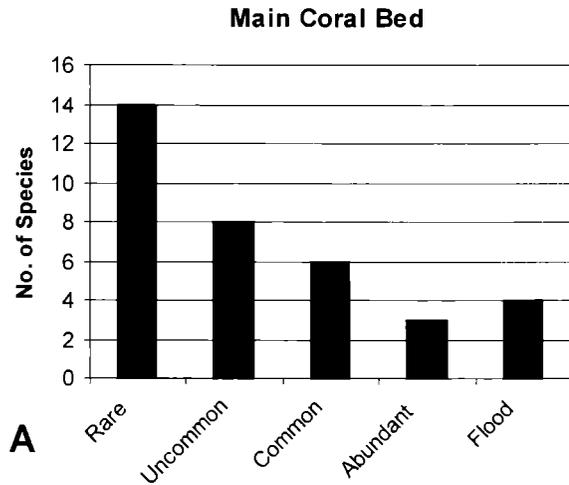## Representative Oligocene Site

B

Fig. 7:
Diversity comparison of Main Coral Bed of Guinea Corn Formation with a representative site from the Late Oligocene Moneague Formation. Species grouped into rarity classes:
Rare – 1–3 specimens,
Uncommon – 4–8 specimens,
Common – 9–15 specimens,
Abundant – 16–30 specimens,
Flood – > 30 specimens.
Main coral bed n = 441;
Late Oligocene site n = 437.

maica. These sites contain abundant well preserved coral that was collected as bulk slabs across thickness and spatial extents similar to that of the MCB. The total number of specimens for each of this sites ranges from 243 to 437. Species richness at the Oligocene sites ranges from 30 to 40. This is clearly similar to richness at our MCB site (35). The overall range of colony forms in the Cretaceous fauna, dominated by massive/columnar species and comparatively few platy forms, is also comparable to that seen in the Oligocene fauna (STEMANN, 2004).

Diversity in the Late Oligocene sites, however, was all somewhat higher than that of the MCB, with Evenness measures all ranging higher than 0.89. One of the differences in H (maximum Oligocene value of 1.45) was statistically significant. This difference in diversity can be seen graphically in Fig. 7 depicting numbers of species whose occurrences were rare (1–3 specimens), uncommon (4–8 specimens), common (9–15 specimens), abundant (16–30 specimens) or a flood (>30 specimens). The Oligocene site with the greatest number of specimens (437) has a higher proportion of common and abundant species than does the MCB. This is common for all Oligocene species-rich samples examined. The slightly lower diversity measures for the MCB may be the result of the particular dominance of the branched coral *Actinacis* A at this site. This may reflect the more turbid, silici-clastic sediment rich depositional environments that existed in Jamaica during the Late Cretaceous (MITCHELL, 2002b). Branched *Actinacis* spp. similar to those in our Main Coral Bed are often considered to be hardy generalists capable of withstanding considerable sedimentation stress in the Cenozoic (FROST, 1977; BOSELLINI & STEMANN, 1996).

6. CONCLUSIONS

In summary, our recorded richness and diversity in the latest Maastrichtian of Jamaica are high by Cenozoic standards. Even so, analysis of our sampling suggests that collecting more localities could yield up to 20% more species level taxa. Our most densely sampled site (MCB) also appears to be as taxonomically rich as units from the Late Oligocene of the Caribbean, a time widely considered to be a peak in reef development and perhaps coral diversity in the Caribbean (BUDD, 2000; FROST, 1977).

Thus, there is no evidence for low taxonomic richness before the K-T boundary, neither is there evidence that corals are less abundant or noticeably more ecologically restricted at this time. This is in stark contrast to the sparse, species-poor Caribbean faunas of the Paleocene through Early Eocene (STEMANN, 1997; BUDD, 2000).

The abundance of these corals and their ecologic diversity and importance throughout the Jamaican Maastrichtian also seems to also call for a re-evaluation of Phanerozoic reef models that downplay the importance of the Scleractinia in Late Cretaceous shallow water carbonate environments (KAUFMAN & FAGERSTROM, 1993 and others).

Finally, there do appear to be some faunal differences between inliers and within successions within inliers. These could be related to slight age differences between sample sites in different inliers (STEUBER et al., 2002) and between different parts of the thick Guinea Corn Formation succession in the Central Inlier. Indeed, lithostratigraphic data suggests a clear replacement of *Paracycloseris* species (*P. elizabethae* and *P.* sp. B in this report) through the Guinea Corn Formation. Thus, differences between some of

our sites and inliers may reflect some level of species turnover through the Late Maastrichtian, though our sampling of the entire Late Maastrichtian of Jamaica needs to be expanded to address this question fully. It appears that expanded and integrated lithostratigraphic and biostratigraphic work in the area combined with extensive collecting, will likely yield comprehensive data on a succession of coral faunas through last 1–2 million years of the Cretaceous.

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