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Front Cover: View to the SSE on White Cay in Grahams Harbour off the north coast of San Salvador, Bahamas. At this spectacularly scenic site one can see that marine erosion has removed the entire windward portion of these early Holocene eolianites (North Point Member, with an alochem age of ~5000 radiocarbon years B.P.) that were deposited when sea level was at least 2 meters below its present position.

Back Cover: Stephen Jay Gould, keynote speaker for this symposium, holds a *Cerion rodregoi* at the Chicago Herald Tribune's 1891 monument to the landfall of Christopher Colombus, which is located on the windward coast of Crab Cay on the eastern side of San Salvador Island, Bahamas. The monument consists of an obelisk constructed from local limestone which houses a carved rock sphere depicting the globe with the continents. The inscription carved in a marble slab, reads: "On this spot, Christopher Columbus first set foot upon the soil of the New World."

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TAPHONOMY AND NEOICHNOLOGY OF *STROMBUS GIGAS* (QUEEN CONCH) AT SAN SALVADOR, BAHAMAS

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ABSTRACT

The mesogastropod *Strombus gigas*, commonly known as the queen conch, is the subject of an investigation designed to provide a model for fossil conch taphonomy and ichnology. Taphonomic studies focused on identifying encrusting and boring organisms, the sequence in which the epibionts appear in specific habitats, and their effects (signatures) on the conch shells. Rates of shell fragmentation and degree of abrasion in surf zones were measured using implants at Barker's Point. The combined results of the experimental taphonomic studies will be used to analyze subfossil conchs from North Point, Barkers Point, Sue Point and Fernandez Bay, and fossil conchs at Barker's Point, Cockburn Town Reef, and Conch Point.

Freshly-fished conch shells were tagged, numbered, and colored-coded with fluorescent spray paint to aid in the recovery of specimens from the sea floor. Implant specimens were placed untethered in four sites within Graham's Harbor. They were: (Site 1) the surf zone at Barkers Point, (Site 2) a patch reef north of Barker's Point, (Site 3) a near shore grass bed west of Singer Bar Point, and (Site 4) an offshore grass bed north of Dump Reef. The shells were recovered at 1-month, 3-month, 5-month and 8-month periods. The interiors of the conch shell implants were examined for epibionts using a 10X hand lens and binocular microscope.

The untethered implants produced a variety of unexpected taphonomic conditions. Shells in the surf, not only rolled around, but also became lodged between rocks in the water which resulted in a lack of breakage, or they were thrown onto the back-beach during storm events, which led to intense bleaching of the shells. Implants in the reef and surf show a high degree of variability in epibionts that is in part because of intermittent coverage with sediment during the increased hurricane activity of 1995. Grass bed implants exhibit more uniformity and the highest diversity in epibiont coverage, presumably from the lack of shifting sands.

The distinctive trails of *Strombus gigas* were observed on the sea floor, and were created in the laboratory by live conchs. The tanks were then drained, and the trails were cast for later detailed examination.

INTRODUCTION

Taphonomic studies of molluscs in modern environments, such as the Gulf of California (Fursich and Flessa, 1987; 1991) and the Texas Coast (Davies et al., 1990; Staff and Powell, 1990) have examined mollusc assemblages in siliciclastic, tide-dominated environments. However, comparable studies in carbonate regimes are few. In a major study, Parsons (1992) conducted a survey of various modern environments on St. Croix, U.S. Virgin Islands in an attempt to predict the environment of deposition based on the taphonomic signatures of altered mollusc shells.

Studies focusing specifically on conch taphonomy are rare. Geary and Allmon (1990) investigated the formation of a dense layer of *Strombus floridanus* in the Pliocene "Pinecrest Beds" of Florida. Taphonomic data such as encrustation, borings, and abrasion of the shells were recorded, but no experimental taphonomic studies were done. In the only previous experimental study involving *Strombus gigas*, Parsons (1992) used 5 cm^2 pieces of *Strombus gigas* as fixed substrates.

Although the thick shell of the queen conch would not be expected to decompose readily after death, many encrusting and boring organisms apparently contribute to the breakdown of the shell. Epibionts on shells can indicate original shell orientation and can provide evidence of ecological variables such as light availability, nutrient levels, and amount of energy in the depositional environment (Parsons, 1992). Epibionts also may furnish clues to the depositional environment, and residence time in the environment prior to final burial, as has been found in studies of other molluscs (Davies et al., 1990; Staff and Powell, 1990; Geary and Allmon, 1990; Parsons, 1992).

With regard to ichnology, Parker (1922) described the unique locomotion of *Strombus gigas*, and Iverson (1984) observed the "characteristic" trails of queen conchs made on tidal flats during low tide. He measured tracks up to 30 feet in length, that were made during a single low-tide period, but no further comments were made about the distinctive features of these trails.

The objectives of the present study were to investigate the processes of biological and physical destruction of the shell after death, and to analyze, in detail, the trace making activity of the living *Strombus gigas*. This study is part of a Master of Science thesis, which is currently being completed; the results presented herein are preliminary.

STUDY AREA

The queen conch is found in the western North Atlantic from South America to the Florida Keys and out to Bermuda (Brownell and Stevely, 1981). Throughout its geographic range, the queen conch is an important commercial species, and it has been severely depleted in many areas (Adams, 1970; Brownell, 1977; Stoner and Waite, 1990). The island of San Salvador, Bahamas still maintains relatively healthy queen conch populations, and the species is not subject to strict fisheries regulations at this time. Fossil and subfossil *Strombus gigas* specimens are present at various localities in the Pleistocene and Holocene strata of the island. The available populations, lack of fishery regulations, and the fact that the same species occurs as subfossils and fossils in the same study area make San Salvador an ideal place to conduct comparative research.

NEOICHNOLOGY

Methodology

The queen conch has earned the nickname of the "Hopping Conch" due to its jerky forward motion. Instead of gliding along by muscular waves of the foot like most gastropods, *Strombus gigas* moves in short hops. The conch places its foot against the substrate and pushes itself forward with its operculum, much the same as a pole vaulter might do on a very short pole (Iverson, 1984).

While doing reconnaissance of live populations within Graham's Harbor, we observed and photographed the distinctive trails of the queen conch on the seafloor at water depths of 15-20 feet. Live conchs were brought to the Bahamian Field Station and placed in a tank with flowing sea water and a sand substrate, so they could be observed more closely and they would crawl and make trails. The tank was drained and the trails were cast using Plaster of Paris and latex to make a lightweight duplicate of the trace for further analysis.

Results

Through observations in the field and laboratory experiments, it is clear the *Strombus* trails are distinctive and can be easily differentiated from other invertebrate traces on the seafloor. The most distinguishing characteristic of the trace is the tread-like feature on the righthand side (Figure 1), produced by the combined action of the anterior portion of the foot and the operculum. This feature alone can be used to distinguish *Strombus* trails from those of the helmet shell *Cassis* and the sea-biscuit *Meoma*, which are the two most common trace-making associates of *Strombus*.

EXPERIMENTAL TAPHONOMY

Methodology

Freshly-fished conch shells were tagged, numbered, and color-coded with fluorescent spray paint. The paint enabled us to distinguish the implanted shells from the numerous other empty conch shells on the

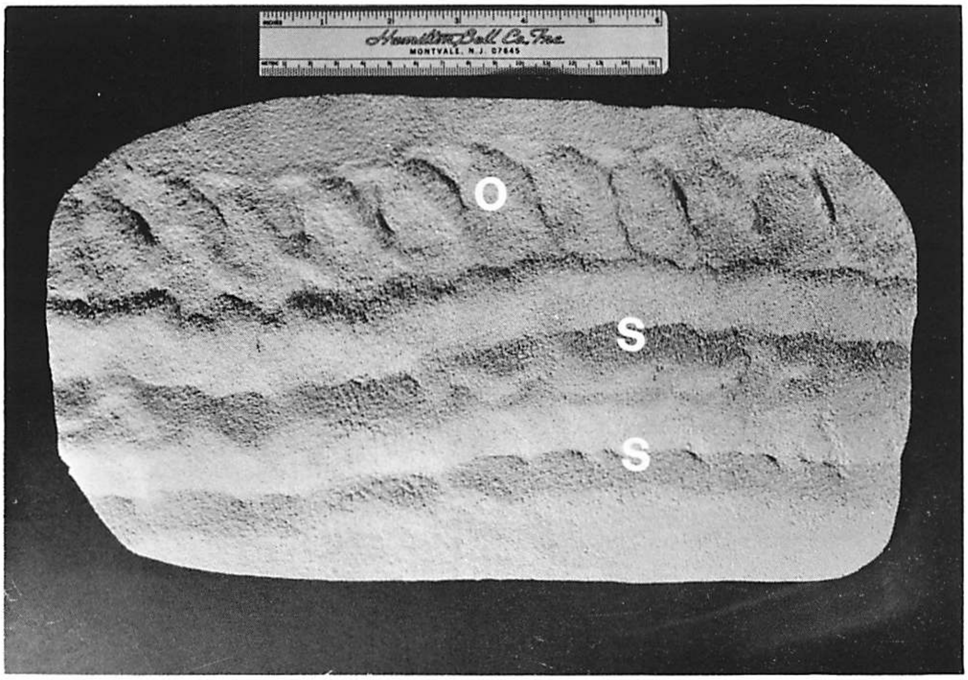


Figure 1. Latex cast of Strombus gigas trace showing the distinguishing features made by the operculum (o) and the spines (s).

seafloor.

Implant specimens were placed, untethered, at four sites within Graham's Harbor: (1) the surf zone at Barker's Point, (2) a patch reef directly offshore from Barker's Point, (3) a nearshore grass bed west of Singer Bar Point, and (4) an offshore grass bed north of Dump Reef.

The implants were recovered at intervals of 1, 3, 5 and 8 months. The exteriors of the shells are colonized by a variety of organisms during the life of the gastropod. Therefore, we examined only the shell interiors in order to distinguish post-mortem effects.

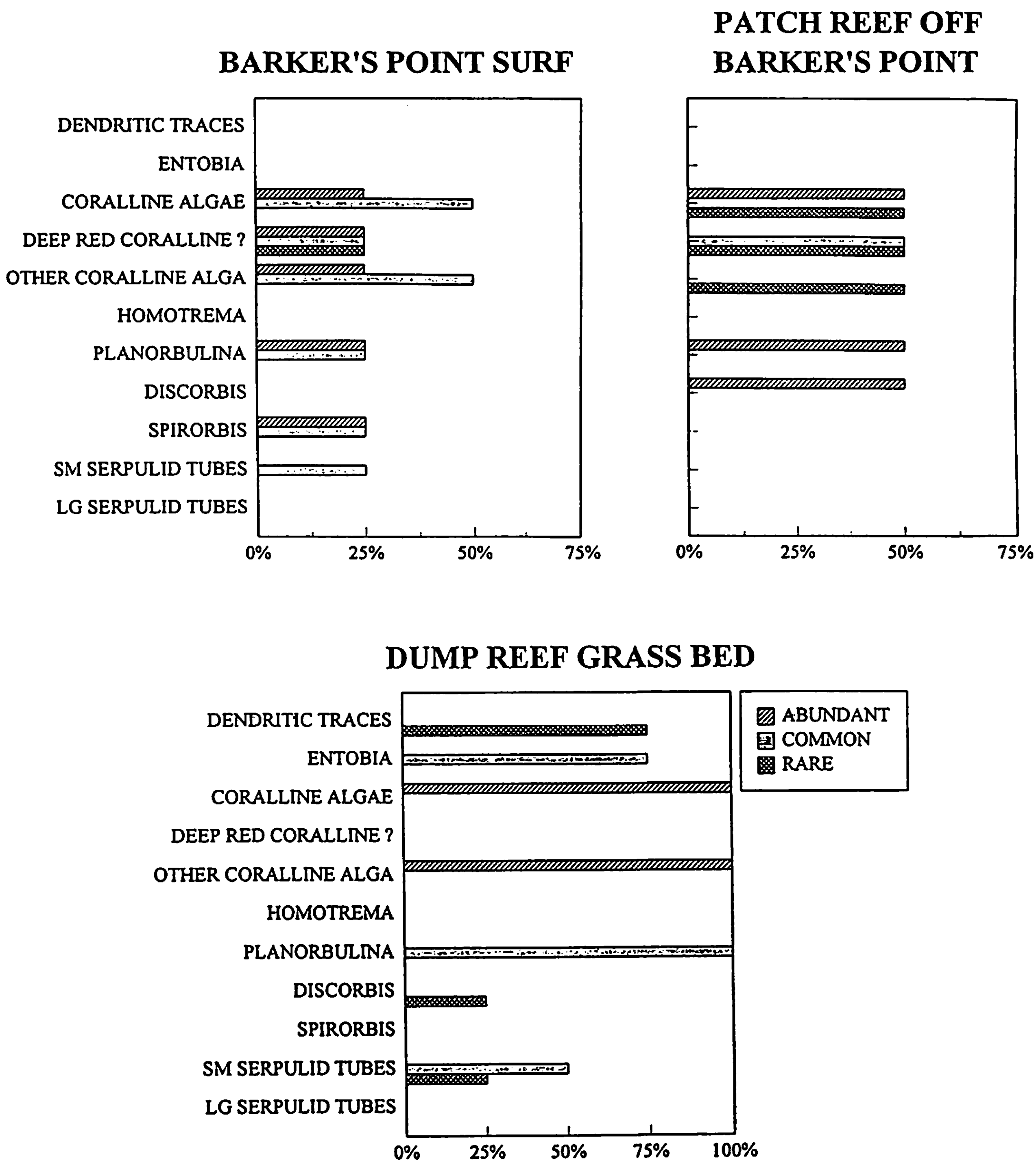
The taphonomic conditions of the conch shells were assessed by using a taphonomic index modeled after Davies et al. (1990). The data discussed here includes degree of breakage within the surf at Barker's Point, and data about the epibionts and borers at all four implant sites. Data collection was semi-quantitative, using the descriptors: abundant, common, rare, and absent.

Results and Discussion

The main types of preservable encrusters and borers found on the implants were identified at various taxonomic levels, but some morphotype designations are used provisionally until more accurate identifications can be made (see Figure 2). One or more types of coralline algae are common, but the term "deep red coralline?" indicates a distinctive form tentatively identified as a coralline alga. Serpulid worms are divided into "small" and "large" categories, plus the genus *Spirorbis*. Clionid sponge borings include isolated circular holes (*Entobia*) and subsurface "dendritic traces". Distinctive attached foraminifera include the genus *Planorbulina*.

At one month, there is generally only sparse epibiont encrustation, but coralline algae are rare to common on 50% of the shells at the patch reef off Barker's Point, and attached foraminifera (*Planorbulina*) are also present. After one month, coralline algae are also present on the shells at the Dump Reef grass bed, and are abundant on 20% of the shells.

After 5 months (Figure 2), some differences between sites become apparent. For example, shells implanted at the Dump Reef grass-bed site have a slightly higher



Figures 2. Relative proportions of epibiont types after 5 months at the surf, reef, and grass-bed sites. Data is in percent of shells covered.

diversity of epibionts and show the most uniformity in epibiont coverage, when compared to implants at other sites. For example, coralline algae are abundant and *Planorbulina* are common on all shells at the Dump Reef site, and sponge borings (the trace *Entobia* and the "dendritic traces") are common to abundant on 75% of the implant specimens there; but they are rarely seen on shells from other sites.

In contrast, the 5-month specimens from the reef and surf show a high degree of variability in epibiont coverage. At the reef site, this may be explained by partial or complete sand burial. In addition, the deep red coralline alga(?) is found only on shells at the two sites near Barker's Point (after 5 months), but its significance is unclear at present.

The most unexpected taphonomic results was the low rate of breakage in the surf. Surf implants were frequently trapped in potholes in the beachrock in the intertidal zone, or lodged in the joints of submerged beachrock, which seems to have protected them from breakage. Still other implant shells were transported onto the back-beach during storms, and this transport out of the surf zone resulted in the absence of epibionts, lack of breakage, and intense bleaching of the shells.

COMMENTS

Clarification of the distinctive trace made by *Strombus gigas* should facilitate recognition of strombid traces in the rock record. Further analysis remains to be done to investigate the range of variability shown in the morphology of these traces. Additional analysis of taphonomic data will include the type and extent of shell degradation for implant specimens, and will compare the experimental shells with both subfossil and fossil material.

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REFERENCES

Adams, J. E., 1970, Conch fishing industry of Union Island, Grenadines, West Indies: Journal of Tropical Science, v. 12, p. 279-288.

Brownell, W. N., 1977, Reproduction, laboratory culture and growth of *Strombus gigas*, *S. costatus*, and *S. pugilis* in Los Roques, Venezuela: Bulletin of Marine Science, v. 27, p. 668-680.

Brownell, W. N. and Stevely, J. M., 1981, The biology, fisheries and management of the queen conch, *Strombus gigas*: Marine Fisheries Review, v. 43, p. 1-12.

Davies, D. J., Staff G. M., Callender, W. R. and Powell, E. N., 1990, Description of a quantitative approach to taphonomy and taphofacies analysis: all dead things are not created equal, *in* Miller, E., III, ed., Paleocommunity Temporal Dynamics: The Long-term Development of Multispecies Assemblies: Paleontological Society Special Publication No. 5, p. 328-350.

Fursich, F. T. and Flessa, K. W., 1987, Taphonomy of tidal flat mollusks in the Northern Gulf of California: paleoenvironmental analysis despite the perils of preservation: Palaios, v. 2, p. 543-559.

Fursich, F. T. and Flessa, K. W., 1991, The origin and interpretation of Bahi la Choya (Northern Gulf of California) taphocoenoses: implications for paleoenvironmental analysis: Zitteliana, Abhandlungen der Bayerischen Staatssammlung fur Palaontologie and historische Geologie, v. 18, p. 165-169.

Geary, D. H. and Allmon, W. D., 1990, Biological and physical contributions to the accumulation of strombid gastropods in a Pliocene shell bed: Palaios, v. 5, p. 259-272.

Iverson, E. S., 1984, Queen among mollusks: the hop, hop, hopping conch: Oceans, v. 17, p.30-33.

Parker, G. H., 1922, The leaping of the Stromb (*Strombus gigas*): Journal of Experimental Zoology, v. 36, p. 205-209.

Parsons, K. M., 1992, Taphonomic attributes of mollusks as predictors of environment of deposition in modern carbonate systems: northeastern Caribbean: Ph.D. Dissertation, University of Rochester, 418 p.

Staff, G. M. and Powell, E. N., 1990, Taphonomic signature and the imprint of taphonomic history: discriminating between taphofacies of the inner continental shelf and a microtidal inlet, *in* Miller, E., III, ed., Paleocommunity Temporal Dynamics: The Long-term Development of Multispecies Assemblies: Paleontological Society Special Publication No. 5, p. 370-390.

Stoner, A. W. and Waite, J. M., 1990, Distribution and behavior of queen conch, *Strombus gigas*, relative to seagrass standing crop: U.S. Fishery Bulletin, v. 88, p. 573-585.