# PROCEEDINGS

# OF THE FOURTH SYMPOSIUM

# ON THE GEOLOGY OF THE BAHAMAS

Editor

John E. Mylroie

Production Editor

Donald T. Gerace

Sponsored by the Bahamian Field Station

June 17 - 22, 1988

ISBN 0-935909-31-1

Printed by Don Heuer in the U.S.A.

# BIOTURBATION OF BEACH SANDS BY BETTLES AND ANNELID WORMS SAN SALVADOR ISLAND, BAHAMAS

Robert W. Adams
Department of the Earth Sciences
State University of New York College
Brockport, New York 14420

## ABSTRACT

Beetles, tentatively identified as rove beetles, are present as surface burrowers on three San Salvador Island beaches. Raised "tunnels" 1 mm in diameter, up to 10 cm in length, are common on the high tide swash zone surface. The beetles tunnel and burrow through upper fine- to lower medium-grained, well-rounded beach sand. The burrows are ephemeral features, being destroyed during a subsequent high tide swash event. If the burrows were preserved in the geologic record they would indicate the position of a beach swash zone.

Annelid worms up to 10 cm in length are present in the supratidal and intertidal beach sand of French Bay and East Beach. Sand particles within the worms indicate ingestion and excretion processes while they burrow through the beach material. The vertical and horizontal distribution of the worms suggests probable significant bioturbation and obscuring of stratification within the upper beach zone. Such zones may be interpreted as a shallow marine bioturbated facies rather that a beach facies when observed in the sedimentary record.

## INTRODUCTION

Many tracks, trails, burrows and other organic markings have been observed in the shallow marine, beach and dune environments of San Salvador. Curran and White (1988) have documented the characteristic trace fossils in the shallow subtidal, upper beach and dunal zones of the island. Additional organic activity within the supratidal and foreshore zone (intertidal) by burrowing beetles and worms can be added to the Curran and White model for San Salvador and elsewhere.

## TUNNELING AND BURROWING BEETLES

### Field Observations

Burrowed tunnels are present on the middle to upper foreshore surface of the beach immediately east and west of the Government Dock, Grahams Harbor (Figs.1 and 2). The tunnels are approximately 1 mm in inside diameter and 2 mm in outside diameter (Fig. 3). They range from a few to over 10 cm in length, commonly are oriented normal to the water line and are often sinuous and curved. They appear at about the time of low tide, extending from the middle to upper part of the foreshore.

The tunnels are formed by an insect which lands on the sand, burrows into and through it, and then breaks through to the surface and flies off. The insects are 1.7 to 2.0 mm long and 0.6 to 0.7 mm wide and resemble beetles (Fig. 4). Normally they are found singly along the tunnels (not at the end); rarely two insects may be in the same tunnel.

The above observations were made over several years during the winter months of December and January. In June 1988 additional aspects of these insects were noted. During a period of mixed tides, when the two high tides are of significantly different height, the insects have an opportunity to occupy the intertidal zone between the two high tides for a longer period of time (that portion of the beach not reached by the swash of the lower high tide). The extent of burrowing is greater with large areas of the beach surface completely tunneled including vertical burrows to a depth of 1 cm. Associated with this evidence of intense insect activity are slightly narrower tunnels occupied by insect larvae.

On San Salvador the insects have been found at Grahams Harbor Government Dock, the pocket beach on Cut Cay and the small beach west of the building at the entrance to Pigeon Creek. The sand in which they tunnel is bioclastic

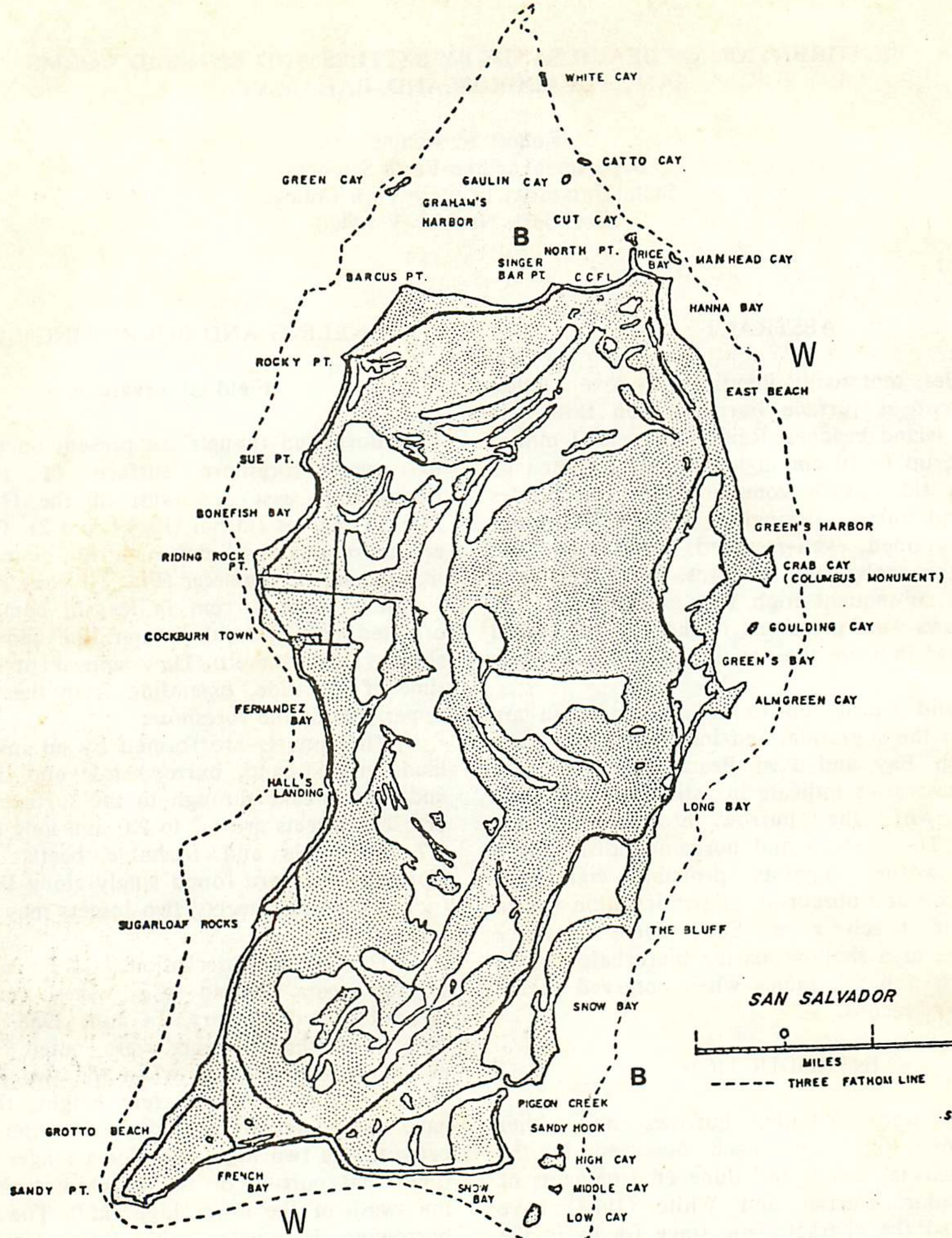



*Fig. 1. Index map of San Salvador. W: Annelid locality, B: Beetle locality.*

*Fig. 2. Insect burrowed tunnels. U.S. penny scale.*


*Fig. 3. Exposed insect tunnels, mm scale.*

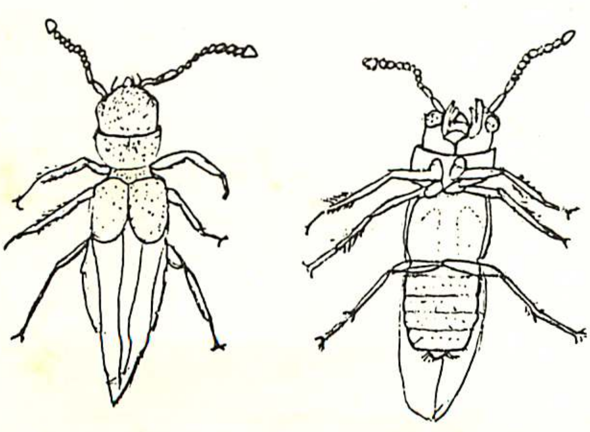
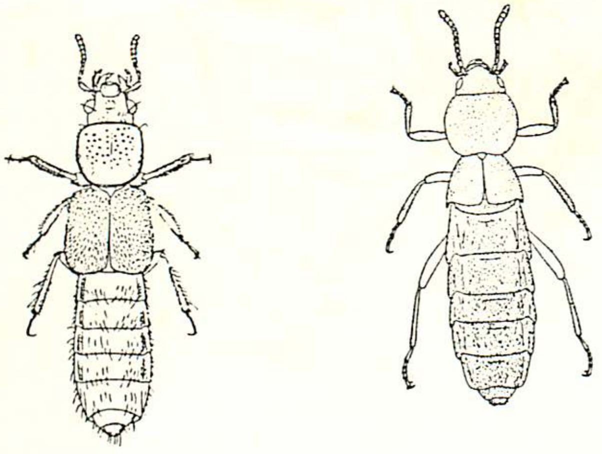


*Fig. 4. Sketch of burrowing insect. 2 mm length.*



A B

*Fig. 5. Beetles: A.* Bledius *sp., B.* Pontamalota *sp. (from White, et al., 1984)*


*Fig. 6. French Bay beach earthworm (dead).*


*Fig. 7. Live earthworm with internal sand grains. French Bay.*

lower medium (250-350 microns, 2 to 1.5 phi) to upper fine (177-250 microns, 2-2.5 phi) and is rounded to subrounded. Active burrowing takes place after the sand dewaters to an appropriate degree during a falling tide.

### Interpretation

Examination of the insects by an entomologist suggests that the insect is an intertidal rove beetle of the order Coleoptera, family Staphylinidae, genus *Bledius*. (A. Bratt, personal communication, July 26, 1988). This family of beetles contains 3000 species in North America (Arnett, 1985) many of which are found in the intertidal marine environment. Two Staphylinidae species are shown in figure 5.

Intertidal rove beetles range in size from 1 to 20 cm (Arnett, 1985) and are predators on insect larvae, snails, insects and crustaceans (Moore and Legner, 1976).

### Significance

The beetle structures have been observed only on the finer-grained beaches of San Salvador. The control on their presence could be grain size, however, sand moisture, food availability and reproductive cycle are additional considerations for their distribution. Such features formed in the intertidal zone are subject to destruction during a subsequent high tide event. The presence of "tunneling" larvae that may have hatched from buried eggs and vertical burrowing suggest that bioturbation of beach laminations in the upper centimeter of the beach has taken place. Rare preservation of the tunnels, vertical burrows or an extensive bioturbated thin bed would indicate the position of the middle to upper foreshore of the beach.

## ANNELIDS

### Field Observations

An annelid is present in the intertidal foreshore beach sand immediately to the east of the Government Pier in French Bay and in the sand of the high tide flat at East Beach (Fig 1.). In the middle and lower foreshore the worms are found in a vertical position with their heads 3 to 9 cm below the surface. In the upper foreshore the worms are about 3 cm below the surface in a horizontal position. At East beach they are found to a depth of 15 cm in apparently homogenous sand. They are up to 10 cm long (alive, 5.5 cm dead) and 2 mm in diameter (Fig. 6). Close examination shows a "trail" of sand grains within and extending the length of each worm (Fig. 7). The grain size of the beach sand ranges from 1 mm to .25 mm (0 to 2 phi) in diameter with the mean .5 to .35 mm (1.5 to 1 phi). The worm resembles the common earthworm (Class Oligochaeta) of which there are over 3000 species. It has been identified as an earthworm (K. Fauchald, personal communication, July 18, 1988).

### Significance

The bioturbation by worms of the beach sand can be significant. In one study of such worms (Dales, 1967) it was reported that small worms of this type eat about 84 grams of sand per year, replacing what is in them every 15 minutes. The San Salvador worms are probably larger (the content of one would be significant) and they must "turn over" a large amount of sand annually. Homogenous or bioturbated zones found in the upper beach facies of the Pleistocene and Holocene rocks of the area may be caused by such organisms.

## CONCLUSION

The beaches of San Salvador contain significant evidence of burrowing by insects and worms. Documentation of what is present will provide new data which may be useful for interpreting ancient marine sequences. The Curran and White trace fossil model of the upper beach rocks and eolianites on San Salvador can be modified to include such new features.

The author has found a polychaete in the East Beach area and Curran has reported a worm at Bonefish Bay (H. A. Curran, personal communication, July 1988). Careful examination of the beaches of San Salvador and other Bahamian islands should extend the known distribution of these faunal elements and their record in the sediments and rocks of the region.

## ACKNOWLEDGEMENTS

Field work for this research was conducted during the residence of the Brockport Department of the Earth Sciences Oceanography Practicum courses at The College Center of the Finger Lakes Field Station. Dr. Donald T. Gerace provided logistical support and encouragement during these periods. Dr. H. A. Curran suggested additional locations for annelids. Dr. Alan Bratt, Biology Department, Calvin College, Michigan and Dr. Kristian Fauchald, Smithsonian Institution, assisted in insect and worm identification respectively.

## REFERENCES CITED

Arnett, R.H., Jr., 1985, American Insects: New York, Van Nostrand Reinhold, p. 301.

Curran, H.A. and White, B., 1987, Trace fossils in carbonate upper beach rocks and eolianites: recognition of the backshore to dune transition, in Curran, H.A., ed., Proceedings of the third symposium on the geology of the Bahamas: Fort Lauderdale, Florida, CCFL Bahamian Field Station, p. 243-254.

Dales, R.P., 1967, Annelids: London, United Kingdom, Hutchinson University Library, p. 47.

Moore, I. and Legner, E.F., 1976, Intertidal rove beetles (Coleoptera: staphylinidae), in Cheng, L., ed., Marine Insects: Oxford, United Kingdom, North-Holland, p. 521-551.

White, D.S., Brigham, W.U., and Doyen, J.T., 1984, Aquatic Coleoptera, in Merritt, R.W. and Cummins, K.W., eds., An introduction to the aquatic insects of North America, second ed.: Dubuque, Iowa, Kendall Hunt, p. 361-437.