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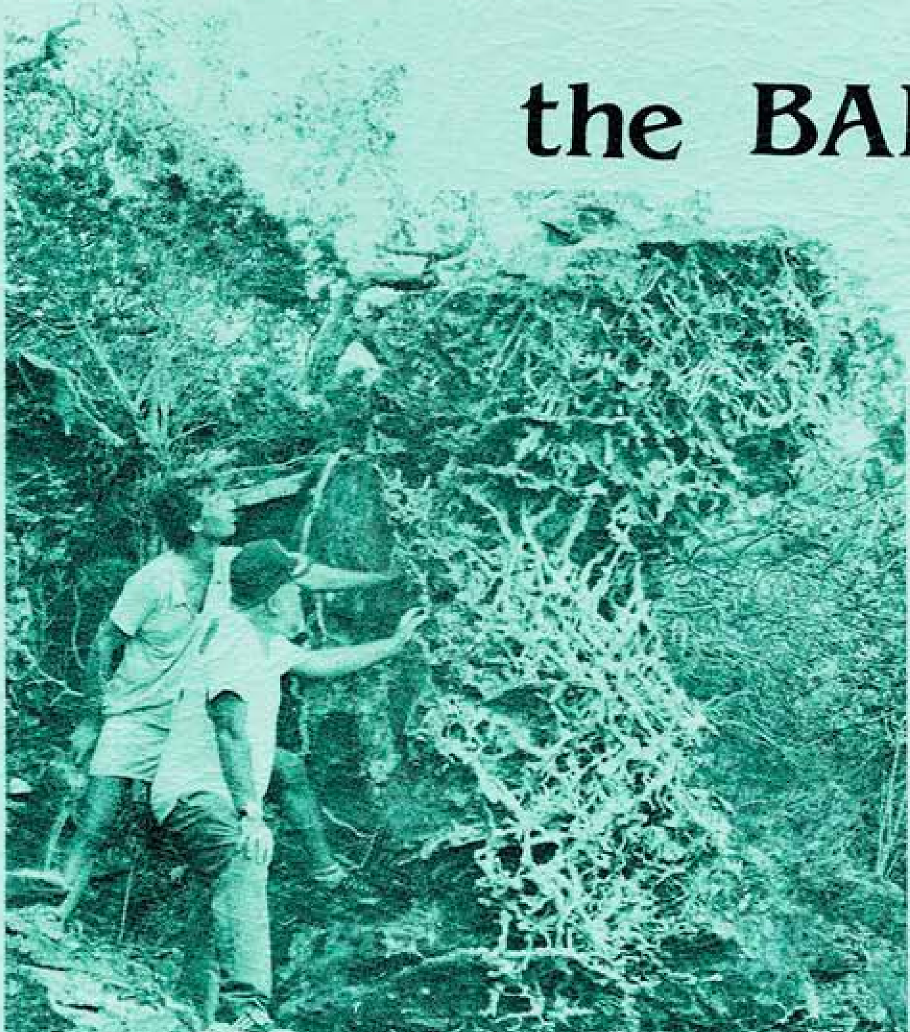

June 1984

CCFL Bahamian Field Station

ALGAL MOUNDS IN STORR'S LAKE, SAN SALVADOR, BAHAMAS

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Abstract

Two species of the filamenteous, cyanophycean genus *Phormidium* jointly form mounds in shallow water of a small embayment of Storr's Lake, San Salvador Island, Bahamas. Although *Phormidium* species are known to form stromatolites in both normal marine waters and brackish waters elsewhere, the mounds that are growing in Storr's Lake today lack laminations characteristic of true stromatolites. They are more appropriately called thrombolites. Absence of calcareous laminations is inferred here to be a result of inadequate quantities of suspended inorganic matter in lake waters due to a dense algal mat on the floor of the lake. Turbid waters of Storr's Lake on at least two occasions carried only suspended organic material. Some calcareous grains and small shells of invertebrates are found within the algal mounds but laminations are almost entirely lacking; lineations that are present, suggesting faint lamination, are discontinuous and poorly developed.

Introduction

Stromatolites in some of Earth's oldest strata have long been recognized and are well known, but living forms went unrecognized until Walcott (1914) associated fossil stromatolites with living fresh water calcareous concretions. Fresh water and brackish water stromatolitic forms remain least well known of any growing today; thus all existing ones in lacustrine environments are noteworthy. San Salvador Island, Bahamas seems to have such occurrences in many lakes of the island (Donald Gerace, personal communication, 1983).

Those growing in Storr's Lake (Figure 1) were brought to our attention in 1983 by Dr. Donald Gerace, Director of the CCFL Bahamian Field Station on San Salvador Island. This occurrence has been described previously by Hattin (1982).

Algal Mounds in Storr's Lake

Algal samples reported here were collected in a small embayment on the west side of Storr's Lake (San Salvador Topographic Map Sheet 2; Universal Transvere Coordinates 18Q & R WB 55610, 60640). No other portion of Storr's Lake was surveyed beyond this small reentrant to determine total extent and distribution of similar algal structures in Storr's Lake.

Typically, the algal mounds are about 10 cm (4 in) high with a maximum observed height of 20 cm (8 in). They are formed in water depths of 15 to 35 cm (14 in. max.). Lake levels apparently fluctuate daily with tidal rise and fall of the ocean. However, diurnal changes in Storr's Lake were not measured and correlated either temporally or quantitatively with normal marine tidal movements. However, maximum and minimum traces of the lake shoreline in the embayment in the vicinity of the algal mounds indicates a normal oscillation of about 15 cm (6 in). Some small algal mounds in the shallowest water are emergent during low water levels of the tidal cycle.

Mounds tend to be cushion-shaped or brevilobate with diameters ranging from about 10 cm to as large as 50-60 cm (24 in max). Mounds are distributed with an open spacing (Hofmann, 1969) and are unlinked.

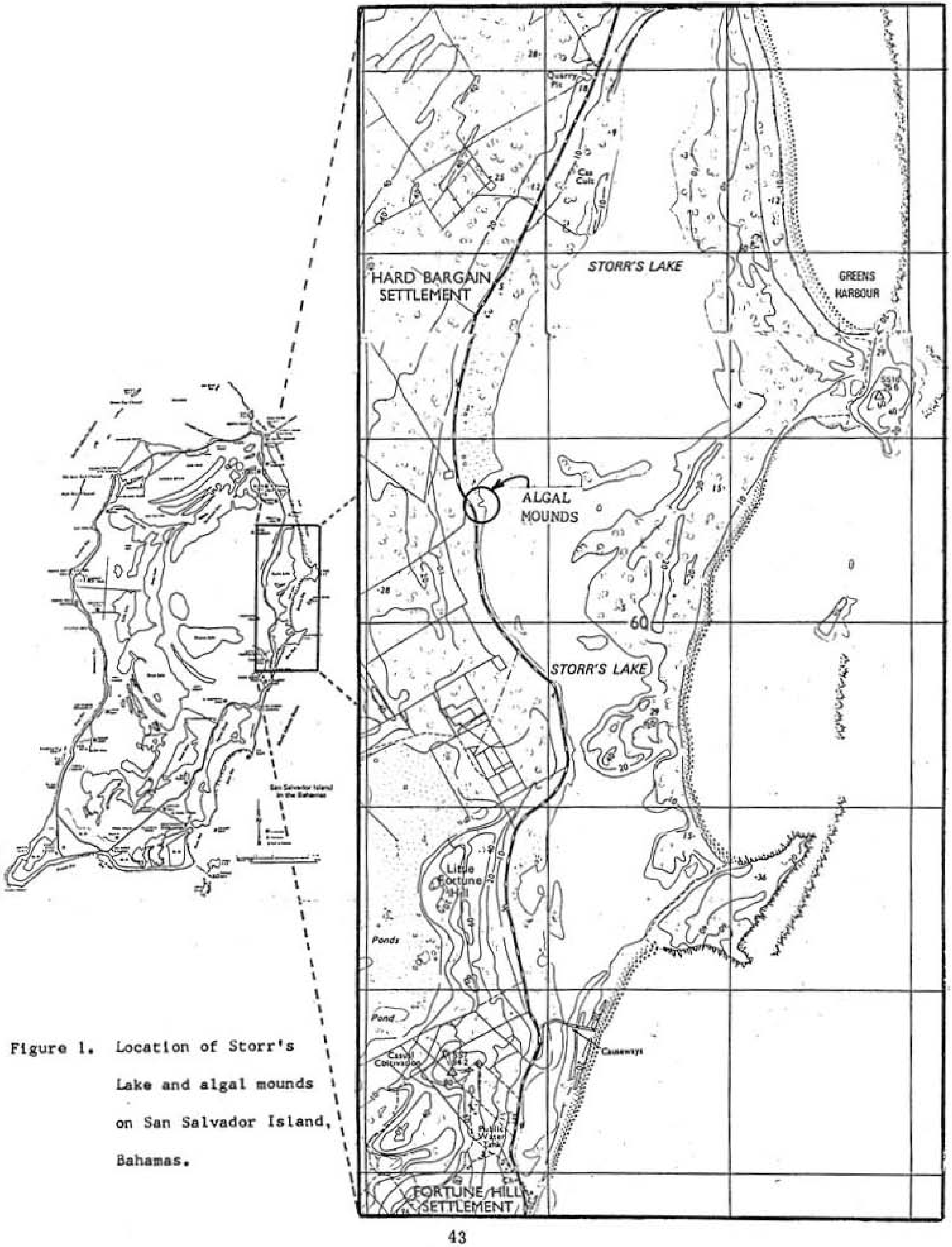

Figure 1. Location of Storr's Lake and algal mounds on San Salvador Island, Bahamas.

Although the upper surface of each mound is basically flat, it tends to consist of small, slightly convex, upward domes of small relief (about 5 mm high) and small size (4.5 cm diameter) which can best be described as crenulated. Mounds which are continuously submerged during tidal cycles are soft and gelatinous throughout; whereas those which are emergent during portions of the tidal cycle are characterized by irregular, tough leatherlike exterior surfaces, although they may be soft and gelatinous beneath the dried exterior material.

The mounds are formed on and project above the floor of the lake, which within the reentrant is covered by a cyanophycean algal mat about 2 mm thick overlying unconsolidated calcareous material about 10 cm thick which, in turn, overlies a well indurated hardground of calcareous material about 1 cm thick. This mat is similar in many respects to one described on Abaco (Neumann, et al, 1970).

Hattin (1982) reports that many gelatinous algal mounds in Storr's Lake contain crumbly limestone knobs up to 15-20 cm in diameter and 12-15 cm high that form a base for the growing algae. These limestone knobs contain a crude lamination. None of these knob structures were discovered or sampled in our investigations because only limited sampling was permitted to ensure minimum disturbance to the algae and algal structures.

Microstructure of Algal Mounds

Storr's Lake algal mounds contain shells of invertebrates and calcareous granules. Shells are small, thin walled, almost transparent calcareous skeletons of ostracods, juvenile pelecypods and gastropods, and foraminifera. Ostracod and foraminifera shells tend to be abundant whereas pelecypod and gastropod shell numbers are fewer and tend to fluctuate more in quantity. Calcareous grains or granules range up to 0.5 mm in diameter and may exhibit a faint clumping or aggregation which overall tend to be randomly distributed.

Totally submerged algal structures are massive and do not exhibit any consistent organic or inorganic structure, especially laminations, even when examined following staining. They can be described best as laminoid fabric (Monty, 1976) and probably should be referred to as 'thrombolites' (Aitken, 1967) rather than stromatolites. Thrombolites are "...structures related to stromatolites, but lacking lamination..." (Aitken, 1967).

Mounds which are emergent do have a lamination in the upper part which may be due more to desiccation than trapping detrital calcareous sediment. Absence of typical stromatolitic laminations in Storr's Lake algal structures which are totally submerged is inferred to be due to an absence of any adequate quantity of suspended calcareous material in the lake water. This has been true on the two occasions (March 1983 and 1984) when the Storr's Lake water was analysed for suspended inorganics. Presumably, the algal mat covering the bottom of Storr's Lake prevents normal wind and wave action and water movement within the lake from carrying fine inorganic particles, except infrequently following heavy rains or strong storms.

Algae Forming the Mounds

Two species of the cyanophycean genus Phormidium are jointly responsible for development of algal mounds in Storr's Lake. The dominate species, as yet unidentified, possesses trichomes of small diameter (0.8 - 1.2 μm) and is concentrated throughout the mounds. The second Phormidium species, also unidentified, is distinguished by trichomes of larger diameter (2 - 2.5 μm) and produces sheaths that are more distinct. This second species is much less abundant and occurs more or less randomly throughout the mounds. Both species grow together in an intimate association of intertwinning filaments, each producing a mucilaginous sheath. Collectively, they form algal mounds and are primarily responsible for their thick gelatinous consistency. Also present within these mounds are numerous other algae, including other blue-green algae (both trichome-forming and unicellular) as well as diatoms.

The dominant species appears similar to Phormidium hendersonii (Howe, 1918), except for the smaller diameter of its trichomes. Phormidium hendersonii is well known for its ability to form present day stromatolites (Golubic and Focke, 1978; Monty, 1978) by trapping fine suspended sediment from the water by means of its mucilaginous sheaths. Moreover, it is now generally recognized that many previous reports of stromatolite formation by Schizothrix calcicola were in error (Golubic and Focke, 1978; Monty, 1978), and that the organism involved in producing these stromatolites was, in fact, P. hendersonii. Accordingly, Phormidium species may now be implicated with present day stromatolitic growths in marine (Monty, 1972, 1978, 1979; Golubic and Focke, 1978), fresh water (Fritsch, 1929, 1949, 1950; Warton, et al., 1982) and presumably, brackish water environments (Monty, 1967; Monty and Hardie, 1976).

Water Chemistry

Water sampled on 12 March 1984 in the vicinity of the mounds was analysed in the field by Warren Wood and found to have a pH of 8.64, salinity of 46,000 ppm, temperature of 26 degrees C, CO_3 content of 39 mg/l, and HCO_3 content of 167 mg/l (Wood, personal communications, 1984). All suspended material in the water was organic matter. This is the only reliable analysis of water from Storr's Lake which we have obtained. Temperatures were measured repeatedly during the week of March 10-16, 1984 but only twice (28 March and 1 April) in 1983. All measurements were taken about 0900-1000 h. and temperatures ranged from 26-27 degrees C.

Only limited water data are available for any lakes on San Salvador Island. Results of work by U.S.G.S. personnel in limited sampling during March of 1983 and 1984, however, indicates that significant changes in water chemistry may occur (Wood, personal communication, 1984). For example, one lake apparently was hypersaline in 1983, when salinity was more than twice normal marine, but brackish in 1984, when salinity was about half normal marine.

Thus more data is needed to determine variability of Storr's Lake throughout an annual cycle.

Conclusions

Algal mounds of Storr's Lake, San Salvador Island are being constructed by two species of Phormidium, a common filamentous blue-green algal genus known to construct stromatolitic structures in present day marine and brackish water environments. The algal mounds in Storr's Lake, however, do not have the well developed laminations typical and distinctive of true stromatolites and therefore are more appropriately referred to as thrombolites.

More work remains to be done before the algae of Storr's Lake are understood. Species determinations must still be made, and information should be obtained pertaining to the period of active growth diurnally and seasonally for the algae producing the thrombolites. Data on water chemistry fluctuations throughout the annual cycles must be determined. Daily tidal cycles and ranges in the nearby sea should be correlated with daily water changes in Storr's Lake. Sediment suspended and transported by lake water must be determined throughout the year and correlated with other climatic and physical factors.

These questions must be added to those raised by Hattin (1982) and shall be answered only by careful study and observation of the behavior of the Storr's Lake algae over an extended interval.

Acknowledgments

We wish to express our appreciation to Donald Gerace who introduced us to the algal mounds of Storr's Lake; to Hanne Kaas, Insitut for Sporeplanter, University of Copenhagen, for assistance in algal identification and discussion of taxonomic problems; and to Warren Wood, U.S. Geological Survey, Reston, for water analysis in the field.

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