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HIGH productivity is synonomous with a concept of the marine sea grass association. Odum *et al.* (1959) summarized this idea after working on primary productivity of marine grass beds in several geographic locations.

This paper constitutes a report of a relatively inconspicuous but significant community of both plants and animals found within the Florida sea grass association. The dominant algae in the community were blue-greens.

Portions of the community occurred as floating masses. Reports came concerning the feeding of mullet on floating algal masses (locally called "mullet gunk"), especially near Johns Pass, near St. Petersburg. In the Philippines this algal community (locally called "lab-lab") was cultivated as fish food (Rabanal, 1949). Flint (1956) reported the common occurrence of filaments of several blue-green algal species in shrimp stomachs. In my Florida observations community development occurred in areas and at times coincident with the appearance of thousands of small fish. It is assumed that the community aids in supporting this influx of feeders. (I have observed small fish in Puget Sound, Washington, nibbling on blue-green epiphytic on leaves of *Zostera marina* L.).

The following papers list community development of blue-green algae in fresh-water: Minnesota (Buell, 1938), Colorado, (Pennak, 1949), and North Carolina (Phillips, 1958). Two papers mention a large scale development of *Lyngbya majuscula* Harv., a blue-green alga, in marine waters of northwest Florida (Humm, 1956), and Bermuda (Bernatowicz, 1952). I found *L. majuscula* a major component of floating algal colonies in at least two Florida marine areas. In northwest Florida Humm (*op. cit.*) reported that *L. majuscula* became a drifting form. In all cases the basic principle concerning composition and structure of the community was similar.

DESCRIPTION OF COMMUNITIES

These observations were made from 1957-1961, concentrating in the Tampa Bay area and in the Indian River near St. Lucie Inlet.

The ontogeny of these marine communities was identical to that found in fresh-water (Phillips, *op. cit.*). Community growth started as patches of blue-green algal scum over substrate and leaves of attached plants (*Diplanthera wrightii* Aschers. and *Ruppia maritima* L. in this study). Gradually patches coalesced through marginal expansion, and a mat of algae was formed over the bottom. Owing to gelatinous secretions of the algae concerned, individual filaments were bound together, forming a relatively tough surface layer. This layer was composed of living, brilliantly colored blue-green algae, either *Spirulina subsalsa* Oerstedt var. *oceanica* Gom. or *Lyngbya majuscula* Harv., depending on the marine habitat. Below was a layer of dead and dying trichomes of these species, in which protozoa, nematodes, and bacteria were most active. Below this layer mud particles of the substrate were consolidated to the mass. Thousands of diatoms, and many crustacea and phytoplankton were scattered throughout the mass below the surface layer of living algae.

During daylight hours gas was produced by the algal mat. The gas was trapped by the gelatinous mat surface. As gas accumulated portions of the mat swelled, tore away from the bottom, and floated to the water surface. This phenomenon occurred only on windless days as turbulent water broke up the floating colony. Floating colonies were not found early in the morning or late in the afternoon.

Size of the floating masses varied, but usually did not exceed 10 cm. Thickness also varied, but usually ranged from 4-10 mm.

The color of the colony was black. According to Buell (*op. cit.*) phycoërythrin predominates under low light intensity and imposes a black appearance on a blue-green algal mass. In marine areas where these colonies developed, waters were relatively murky owing to the silty nature of the substrate. In North Carolina (Phillips *op. cit.*) colonies were bright green, resulting from a predominance of phycocyanin, characteristic of high light intensity.

DISCUSSION

In two experiments muddy sand substrate was brought to the laboratory from Tampa Bay. *Diplanthera wrightii* Aschers. colonized this substrate in the field. No community development was evident in the field at the time of substrate collection. In both experiments substrate was placed in two 15-gallon aquaria, filled with brackish water also from Tampa Bay. The aquaria were illuminated continuously with two 40-watt fluorescent lights. A constant water salinity of 22-24 o/oo was maintained. Water temperatures were those of the room, 26-27°C.

In one experiment both aquaria were aerated. Within two weeks a blue-green algal mat appeared and covered the substrate in one tank. No development beyond the mat stage was attained. In the other experiment one teaspoon of 10-10-10 liquid fertilizer was added to both aquaria once a week, but only one tank received aeration. In 17 days both aquaria evidenced an algal scum over the substrate and on the aquaria sides. In the tank given aeration there was no algal development beyod the scum stage. In the aquarium given no aeration a definite algal mat developed in 22 days. In 28 days the entire aquarium was filled with this algal growth. Several floating colonies, buoyed up by entrapped gas, developed from the substrate surface mat. A sickening stench of H_2S was detected over a radius of several feet around the aquarium. It appeared that aeration inhibited prodigious algal growth in the laboratory. The dominant alga in the aquarium experiments was *Spirulina*.

In the field colonies formed in shallow water, three feet deep or less, over a muddy sand bottom. Wherever the algal community developed attached sea grasses were found. The algal colonies in the field appeared in late summer, coincident with maximum water temperatures, which rose to 29-34°C. over the shallow flats. From the summer of 1960 through the winter of 1961 a very dense coverage of a blue-green algal mat occurred over *R. maritima* L. in most of Old Tampa Bay. This community consisted in major part of *Spirulina*, with an admixture of *Oscillatoria subuliformis* Kutz. On one occasion *Anacystis dimidiata* Dr. & Daily was found accompanying *Spirulina*.

The dominant alga in the community differed according to the salinity of the habitat. In Tampa Bay annual mean salinity varied from approximately 20.0-25.0 o/oo. In these areas *Spirulina* was dominant. In Boca Ciega Bay near St. Petersburg and in Indian River near St. Lucie Inlet, where mean annual salinity exceeded 27.5 o/oo, *Lyngbya* was the dominant form. The latter was also dominant in the high salinity areas in northwest Florida reported by Humm (*op. cit.*) and at Bermuda (Bernatowicz, *op. cit.*).

In all marine areas where these algal communities were observed, hydrogen sulfide was detected in great quantity. Bernatowicz (*op. cit.*) noted the same phenomenon in Bermuda. In the aquarium experiments a hypodermic needle was inserted into several gas bubbles in floating colonies. Gas was extracted and expelled onto moist pH indicator paper. According to the color change, the pH of the gas was definitely below pH 7.0, probably between 6.0-7.0. It is presumed that the gas in the bubbles buoying the floating mass was H_2S. The brackish water in the aquarium was at approximately pH 8.0, as was water from the natural habitat.

A study of the local effects of the pH phenomenon might help to explain bay and estuarine distribution of plants and animals. In one aquarium experiment sea grass plants in the tank died with the appearance of the algal masses and H_2S. Several factors could account for this, among them exhaustion of nutrients, light shading, or H_2S appearance. An interesting problem is the mechanism that sea grasses possess in nature in buffering the deleterious effects of H_2S, which is always present in the substrate. A more fundamental problem is the origin of the H_2S. A very interesting problem in this regard lies in the role of bacteria in colony activity.

Algal mats influence local habitat conditions in various ways. Mats grow over sea grass leaves, screening off light and adding a mechanical factor of weight to leaves. In addition H_2S is added to the habitat, more than that normally present. These factors are probably inimical to the growth of sea grasses. However, the algal community offsets these negative factors in their probable source of food for many marine animals, by probable addition of nutrients to the water when mats decay, and by possible addition of O_2 to the water in photosynthesis, which may, however, not influence the habitat owing to the presence of a large amount of sulfide ion.

One further observation seems pertinent. At Cats Point Bank in Boca Ciega Bay in January 1958 floating colonies, first thought to be of blue-green algae, proved to be a species of photosynthetic sulfur bacterium, possibly *Chlorobium*. This phenomenon is not understood, as in December 1957 the bottom community and floating colonies at this station consisted of *Lyngbya majuscula,* a form not found at the station in January 1958.

Such algal mats seem to exert a nutritional role in nature. They undoubtedly also hasten the emergence of shallow submerged flats by the deposition of organic detritus. The biomass of blue-green algae produced is large. The deposition of silt by colonies adds to that contributed by the sea grass community itself. Substrates in beds of sea grasses, especially in sheltered areas, are often soft and muddy. Where growth is dense and abundant, the algal community may significantly influence the habitat in many interacting complex ways.

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SUMMARY

A community of blue-green algae was observed in several Florida marine habitats. The community in all cases formed over sea grasses. The ontogeny and composition of the community was discussed. Portions of the community floated to the surface as gas, probably H_2S, formed within the algal mass. The algae are significant in that they exert a nutritional role and contribute much organic detritus to the substrate.

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