# OBSERVATIONS ON MICROCOLEUS LYNGBYACEUS (KÜTZ.) CROUAN FROM MARINE HABITATS IN NEW ENGLAND[1]

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Speciation in the Cyanophyta traditionally has emphasized morphological characteristics. Such features as cell size, the absence or presence and nature of a sheath, patterns of branching, presence and arrangement of heterocysts and akinetes, etc., are all familiar criteria used to discern the various families, genera, and species of bluegreen algae.

Within recent years, increasingly critical examinations of both field and cultured material have revealed a high incidence of morphological plasticity among numerous cyanophytes, such plasticity being hitherto either unknown or unappreciated.

Treating only the coccoid Cyanophyceae, Drouet & Daily (1956) showed that many genera and species are ecological variants of a smaller number of entities. For example, 78 taxa were shown by these authors to be ecophenes of one species, *Entophysalis deusta*. In culture studies with this organism, van Reine & van den Hoek (1966) more recently have induced morphological variants previously recognized as 4 genera.

While still comparatively few in number, some studies have been made on the filamentous bluegreen algae. The most ambitious efforts directed toward a more accurate interpretation of variation among filamentous forms have been those of Drouet (1962, with *Microcoleus vaginatus;* 1963, with *Schizothrix calcicola;* 1964, with *Microcoleus chthonoplastes;* 1968, with the Oscillatoriaceae). In addi-

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[2]The author appreciates the constructive criticisms of Dr. Francis Drouet and Dr. John Blum in the preparation of this manuscript.

tion, studies of filamentous bluegreens which further support the inappropriateness of the older taxonomic criteria are those of Stein (1963) and Pearson & Kingsbury (1966).

The occurrence of ecophenes among Massachusetts salt marsh populations of filamentous cyanophytes (Webber, 1967) has prompted further study of these interesting plants. A continuing field and laboratory research program of New England coastal bluegreen algae by this author is in progress.[3]

The present paper describes the ecophenes of *Microcoleus lyngbyaceus* as they occur at several New England coastal stations. The ecophenes of *Microcoleus lyngbyaceus* (Kütz.) Crouan reported here are *Hydrocoleum lyngbyaceum* Kütz., *H. glutinosum* (Ag.) Gom., *H. holdenii* Tilden, *Lyngbya aestuarii* (Mert.) Lieb., *L. confervoides* C. Ag., and *L. semiplana* (C. Ag.) J. Ag. Field and laboratory data gathered by the present author from 1967 to 1970 illustrate the morphological plasticity of this common filamentous alga. This evidence, along with that of Drouet (1968), shows that the "species" of *Hydrocoleum* and *Lyngbya* listed above are actually growth forms of a single entity, *Microcoleus lyngbyaceus*, and should not be recognized as discrete taxa.

Collecting stations for the above data include Cape Neddick, Maine (salt marsh), Adams Point, New Hampshire (salt marsh), and Ipswich, Salem, and Nahant, Massachusetts (salt marshes and rocky coast). All specimens have been deposited in the author's herbarium.

Most results reported here were obtained from immediate study of field collected plants. Some data, however, came from cultures. Culture innoculations were made by snipping pieces of trichomes from field collected material and growing them in Erd-Schreiber medium (Provasoli, et. al., 1957) at 12° C under a 12-hour light/dark regime, unless otherwise indicated.

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[3]Supported by grants from Sigma Xi and the American Philosophical Society.

## Discussion of Collections

CAPE NEDDICK, MAINE: *Microcoleus lyngbyaceus* occurs commonly as the *Lyngbya aestuarii* form mixed with *Vaucheria compacta* in the mud of the lower littoral zone. Plants were collected in September, 1967 and were grown in culture for two months. During this period, trichomes of a variety of colors, bluegreen, green, and brown, became apparent; in addition, some trichomes had terminal cells with inflated outer walls, while others lacked this feature. All trichomes were of the same width, regardless of color and the nature of the terminal cell; both characteristics were used previously in *Lyngbya* species determinations.

ADAMS POINT, NEW HAMPSHIRE: The abundance of *M. lyngbyaceus* was apparent here as macroscopic, black, curly growths in the mud of the Spartinetum alterniforetum. Microscopically, the trichomes were variable in size and in pigmentation. Some measured 13-17 $\mu$ wide and were bright bluegreen (*Hydrocoleum lyngbyaceum* and *H. glutinosum*). Others ranged in width from 25-35 $\mu$, and were yellow-brown with broadly rounded terminal cells (*H. holdenii*). Very common, however, were plants 30 $\mu$ in width and grading in pigmentation from bluegreen to yellow; equally common were numerous trichomes 35 $\mu$ wide and bluegreen in color. Further, trichomes ranging in width from 17-35 $\mu$ and encompassing all color gradations from bluegreen to yellow-brown occurred within the same common sheath (coll. 30-69).

IPSWICH and SALEM, MASSACHUSETTS: Preliminary indications of the weakness of criteria used to delineate *Hydrocoleum lyngbyaceum, H. glutinosum,* and *H. holdenii* at an Ipswich salt marsh have been reported (Webber, 1967). Additional collections at this salt marsh made in June, 1968 from mud banks of Fox Creek and from the mud substratum of *Salicornia europaea* on the marsh surface yielded plants whose dimensions and colorations further negate the discreteness of the above mentioned "species".

From these collections I have observed trichomes to move out of the common sheath, i.e., the *Hydrocoleum* form, in which case, after assuming a thick and individual sheath, they then resembled the several species of *Lyngbya* cited above (coll. 12, 13, 15, 16).

Additional collections of *M. lyngbyaceus* have been made (summer, 1970) from an estuarine habitat in Salem, Massachusetts. The plants occur as black films on salt marsh soil at the mouth of this estuary (Salem Harbor), where they have a macroscopic appearance similar to that described above for their presence at Adams Point, N.H. At the head of the marsh approximately ½ mile upstream (Forest River) the alga is apparent as green-black "skins" floating at the surface of the water. At both extremes of this estuarine system, *M. lyngbyaceus* occurs as the *Hydrocoleum holdenii* form. Cultures of this entity were maintained at room temperature for two weeks. At the end of this growth period, the plants exhibited very little organization of the *Hydrocoleum* type. Rather, many trichomes became freed from their common sheath and, as was noted with the Ipswich plants, assumed a *Lyngbya* morphology. In addition, these trichomes showed considerable overlap in those features used traditionally as species criteria, i.e., cell diameters, morphological details of the terminal cell, and pigmentation. Thus, "species determinations" of *Lyngbya confervoides, L. aestuarii, Hydrocoleum glutinosum,* and *H. holdenii* were possible from this cultured material.

NAHANT, MASSACHUSETTS: The habitats of *Microcoleus lyngbyaceus* at Nahant consist of variously sized tide pools and moist rock crevices. Daily summer water temperature and salinity fluctuations in these pools may be either slight or great depending upon their vertical shoreline location, their size, and their degree of exposure to sunlight and wave action. For example, temperature differences between incoming tidal waters and those of the pools may vary from only a few degrees to as much as 11° C. On hot summer days with incoming tides temperature fluctua-

tions of 3-4° C occur several times each minute in the mid to upper littoral pools. On the other hand, and under the same tidal conditions, pools approximately one foot higher upshore undergo increasingly marked temperature changes of a 12° C magnitude, these changes occurring regularly at approximately 3 minute intervals. By far the greatest temperature extremes are to be found in the highest level rock pools, such temperatures commonly exceeding that of the sea water by 18-21° C. The instantaneous vaporization of the sea water as it splashes against the intertidal rocks is clearly indicative of the higher temperatures typical of this segment of the shore.

Salinities in these high rock pools were the maximum recorded along the shore. While these measurements could not be determined precisely, due to the limits of the salinometer used, they were strongly in excess of 42 $^{0}/_{00}$.

*Microcoleus lyngbyaceus* is common along these rocky shores in small (1-8″ deep) upper littoral tide pools, the plant mass appearing macroscopically as skeins of blue-black, orange, or orange-brown material typically 2-3 cm long; microscopically, these are the *Lyngbya* forms (e.g., coll. 11-69). In the deeper (20″) pools, however, filaments of this species were entwined in such a way that they became structured into 6-8″ long gas-filled, brown tubes standing erect from the pool bottom (coll. 32-69). Individual trichomes of these tubes measured 26 $\mu$ wide; filament diameters were commonly 52 $\mu$, the non-lamellated sheaths having roughened margins. The terminal cells of these filaments often had clear and inflated outer walls; hormogonia were abundant. Some of the trichomes comprising these hollow tubes were contained within an obvious common sheath (the *Hydrocoleum* form), while others were not so contained (the *Lyngbya* form).

Additional plants of the *Lyngbya* type from the smaller pools, when cultured at room temperatures for three weeks, changed their morphology and assumed that of *Hydrocoleum,* i.e., several trichomes in twisted strands enveloped by a common sheath (coll. 15-69). Further, plants of *M.*

*lyngbyaceus*, as the *Lyngbya* form, collected during November, 1968 and June, 1969 from tide pools at the Nahant Town Wharf, were consistently uniform in their dimensions, trichomes 17 $\mu$ wide and filaments to 26 $\mu$ wide. However, pigmentation of these trichomes was variable, the plants appearing either greenish-blue, yellow, or yellow-brown.

## LITERATURE CITED


DROUET, F. 1962. Gomont's ecophenes of the bluegreen alga, *Microcoleus vaginatus* (Oscillatoriaceae). Proc. Acad. Nat. Sci. Philadelphia. **114**: 191-205.

———. 1963. Ecophenes of *Schizothrix calcicola* (Oscillatoriaceae). Ibid. **115**: 261-281.

———. 1964. Ecophenes of *Microcoleus chthonoplastes*. Rev. Algol. **4**: 315-324.

———. 1968. Revision of the classification of the Oscillatoriaceae. Monogr. 15. Acad. Nat. Sci. Philadelphia.

———, and W. A. DAILY. 1956. Revision of the coccoid Myxophyceae. Butler Univ. Bot. Stud. 12.

PEARSON, J. E., and J. M. KINGSBURY. 1966. Culturally induced variation in four morphologically diverse bluegreen algae. Amer. J. Bot. **53**: 192-200.

PROVASOLI, L., J. MCLAUGHLIN, and M. DROOP. 1957. The development of artificial media for marine algae. Archiv. Microbiol. **25**: 392-428.

STEIN, J. 1963. Morphological variation of a *Tolypothrix* in culture. Brit. Phyc. Bull. **2**: 206-209.

VAN REINE, W. F. P., and C. VAN DEN HOEK. 1966. Cultural evidence for the morphologic plasticity of *Entophysalis deusta* (Meneghini) Drouet & Daily (Chroococcales, Cyanophyceae). Blumea. **14**: 227-283.

WEBBER, E. E. 1967. Bluegreen algae from a Massachusetts salt marsh. Bull. Torrey Bot. Club. **94**: 99-106.