

**APPENDIX D**

Algae and Cyanobacteria Specie Identification Report  
September 21, 2005

**Report on identification of algae and Cyanobacteria  
(‘bluegreen algae’) in  
saltmarsh mat samples observed**

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## Cyanobacteria of the saltmarsh mats

Cyanobacteria are the dominant life forms of the pieces of salt marsh mat in the samples. They are of the oldest oxygenic photosynthetic organisms, (fossil records go back about 3.2 billion years) tolerate relatively adverse conditions such as drying, freshwater rain, elevated salinity and occasional partly anaerobic conditions and are part of most salt marshes throughout the world. Here they form dense leathery mats of a few to several mm thick. The cyanobacterial mats are generally dark blue green or even black color, are subject to drying and cracking and often develop in panne or otherwise barren areas of salt marshes between stands of *Spartina* and other marsh grasses. Because of the difficulty of distinguishing species with each genus, and the lack of a unified widely accepted taxonomic system I have indicated only the genus of each different kind. Drouet combined many species and even genera and I have largely followed his taxonomy as presented in Humm and Wicks, 1980.<sup>1</sup>

Despite the title of Humm and Wicks' book, bluegreen algae are really bacteria, not algae that are eukaryotic. Bluegreens were referred to as bluegreen algae until the 1970 when they became known as Cyanobacteria reflecting their prokaryotic condition and common evolutionary relationship- to true bacteria. As seen in the samples of cyanobacterial and peat mats observed in samples, the Cyanobacteria seen are a normal and are a common part of the saltmarsh vegetation in otherwise barren areas of the marsh.

### Observations:

Samples were observed while fresh and alive within a few days of their collection. Several small pieces a 2-3 mm diameter were torn from separate areas of each mat, teased apart with forceps on glass slides and were observed under 200 to 1000X magnification with a light microscope. Observations were made and sketches were rendered for each genus observed. Tallies of genera observed in each mat sample are given in table 1.

### Cyanobacteria observed in mat samples:

#### *Rivularia* sp.

Thallus colonies as solid nodular or globular patches 1-3 mm diameter on peat and cyanobacterial mat. Dark greenish black. Each distinct but only a few mm apart and varying sizes. Internally each nodule consists of horizontal or hemispherical bands of radiating trichomes with basal rounded heterocysts with tapered end of trichome pointing upward toward the outer part of nodule and heterocyst toward base of colony. Heterocysts are the cells in which nitrogen fixation occurs.

#### *Oscillatoria* (including *Lyngbya*)

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<sup>1</sup> Humm, H. J. and S. R. Wicks. 1980. Introduction and guide to marine bluegreen algae. John Wiley and Sons. NY. 194 pp.

Dominant filamentous cyanobacterium in mats. Sheathed to varying degrees, sometimes thick and stained yellow orange like *Calothrix* to barely visible sheath in others. Trichomes not tapered, straight and unbranched and without heterocyst. Cells usually shorter than wide. Deep to light blue-green in color except when with thick yellow-orange sheath. *Lyngbya* has been included with this genus as usually done in the literature. Common member of the cyanobacterial mat.

*Calothrix*

Not common in the mat samples but a few specimens were found between more common *Oscillatoria* and *Microcoleus*. Terminal heterocyst and the tapered trichome with a terminal hair-like end within a thick sheath characterized this common intertidal cyanobacterium.

*Microcoleus*

Thin slightly tapered unbranched trichomes lying in a common clear sheath, hundreds in each bundle. No heterocysts. Individual trichomes like thin *Oscillatoria*. Common element of the saltmarsh cyanobacterial mat.

*Arthrospira*

Very much like a very fine *Oscillatoria* but spiraled like a spring and with cross walls so thin almost invisible.

Eucaryotic green algae of the mats:

While not nearly so common as cyanobacteria, several eukaryotic algae occurred.

*Vaucheria*

Siphonous (tubular filaments without cross walls) intermixed with cyanobacteria. Common on many marshes but only a few scattered siphons seen in samples. A member of Xanthophyta or yellow green algae.

*Rhizoclonium*

Unbranched, uniseriate filaments scattered in with cyanobacteria. Not common in samples but often occurs among marsh grasses. Chlorophyta or green algae.

*Spongomorpha*

Only a single branched piece of this normally bushy green alga observed in samples.

*Chlorococcum* (or other unidentified coccoid green alga). Seen only in one sample, the small spheres of this alga form a loose colony or aggregation among the cyanobacterial filaments.

Marsh mat:

I do not know what conditions exist at the marsh in question, but the pieces of marsh mat in the samples sent to me are what one would expect from any New England salt marsh. The mat overlies deposits of underlying peat and sediment. The thickness of mat samples were thin (1-2 mm thick) to moderately thick and

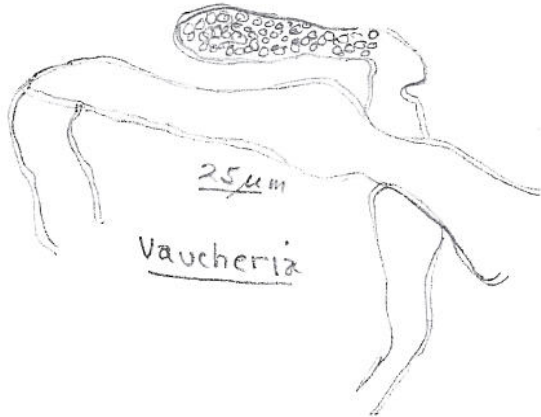
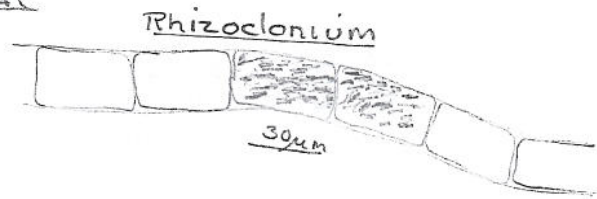


leathery (2-4 (5) mm thick. These mats become dry during neap tides when the marsh is not flooded, or during hot summer months, but come back to life immediately on being rewet. Having survived for billions of years, cyanobacteria are survivors.

Species diversity is what I often see in mats such as those sent. Five species of cyanobacteria and four species of eukaryotic algae were identified. The main components of the mat were *Oscillatoria* and *Microcoleus* with other species as occasional elements except for the mounds of nodule forming *Rivularia*, which dominated one sample (W2A16 #3).

Here I've included here a few sketches of species observed during my microscopic observations of small pieces of mat samples provided.

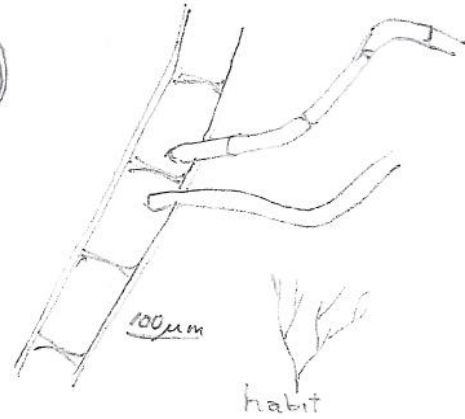
Green algae



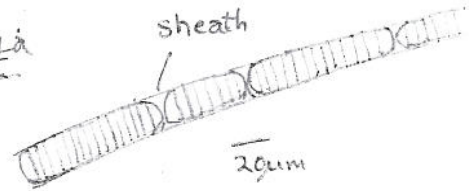
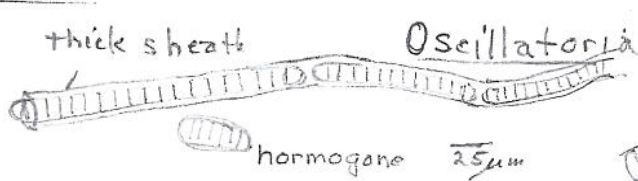
Chlorococcum



Spongomorpha



Cyanobacteria



Trichomes

Microcoleus

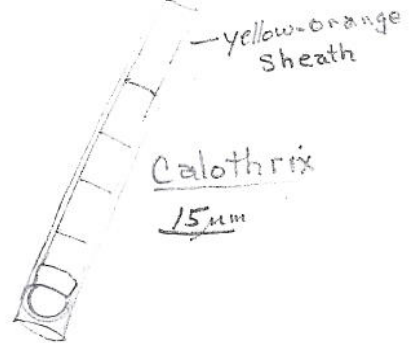
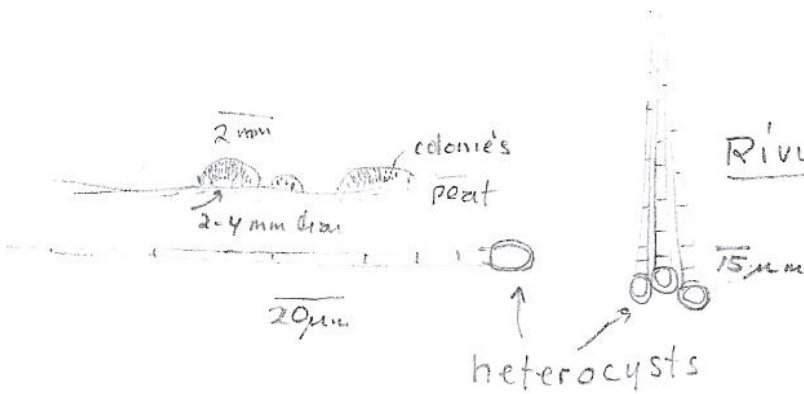
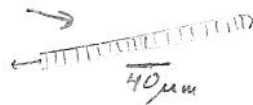
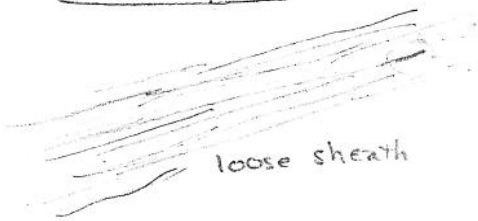


Table 1. Taxa identified in each mat sample as listed by field collecting site.

Station #	<i>Arthrospira</i>	<i>Calothrix</i>	<i>Microcoleus</i>	<i>Oscillatoria</i> <i>spp./Lyngbya</i>	<i>Rivularia</i> <i>sp.</i>	<i>Rhizoclonium</i>	<i>Vaucheria</i>	<i>Chlorococcm</i> ( <i>coccooid</i> <i>green</i> )	<i>Spongomorpha</i>
W2A03 #1	X	x	X	X		X			
W2A03 #2		x		x				x	
W2A03 #3	x		X	x					
W2A10 #1	x	x	X	X			x		
W2A10 #2			x						
W2A10 #3			x	x					
W2A10 #4			X	X			x		
W2A10 #5			x	x				x	x
W2A10 #6			x	X					
W2A 16 #1				X			x		
W2A 16 #2									
W2A 16 #3				X	X				
W2A 16 #4			X	X					

X – common or abundant, greater than 10% of sample observed  
x – less than about 10% of sample observed