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PHYTOPLANKTON IN VIRGINIA LAKES AND RESERVOIRS: PART II

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ABSTRACT

Phytoplankton composition from 16 Virginia lakes and reservoirs are discussed with emphasis on the dominant taxa, algal bloom producers, and potentially harmful species at these locations. This is a companion study to the more comprehensive publication regarding Virginia freshwater phytoplankton by Marshall (2013).

Keywords: phytoplankton, cyanobacteria, lakes, reservoirs, Virginia

INTRODUCTION

The phytoplankton composition from 16 Virginia freshwater habitats was examined as the continuation of a previous survey of 46 Virginia lakes and reservoirs by Marshall (2013). He identified 307 taxa considered representative species at these sites and which are also common in other U.S. north temperate lakes. The major bloom producers at these sites were cyanobacteria that included 6 potential toxin producing species. These were *Anabaena circinalis, Anabaena spiroides, Aphanizomenon flos-aquae, Cylindrospermopsis raciborskii, Limnothrix redekei*, and *Microcystis aeruginosa.* There was concern that due to the aging nature of many of these and other freshwater habitats in Virginia, the likelihood of increased algal blooms occurring, including those by potentially harmful taxa, will become more common and extensive. The objectives of this study include the expanded coverage of Virginia lakes and reservoirs regarding their representative phytoplankton composition, their trophic habitat status, and to identify potentially harmful algal taxa among these populations.

METHODS

Between September 12-29, 2013, surface (<1m) water samples (1000 ml) were taken at 16 Virginia lakes and reservoirs (Fig. 1) not previously included by Marshall (2013). These sites were impoundments generally created decades ago. All water samples were preserved with Lugol's solution (1-2 ml) and returned to the Old Dominion University Phytoplankton Analysis Laboratory for examination. The Utermöhl method with an inverted plankton microscope was used to examine concentrated aliquots of these samples at magnifications of 300X and 600X (Marshall 2013). Cyanobacteria filaments were counted as numbers per ml, with colonial and

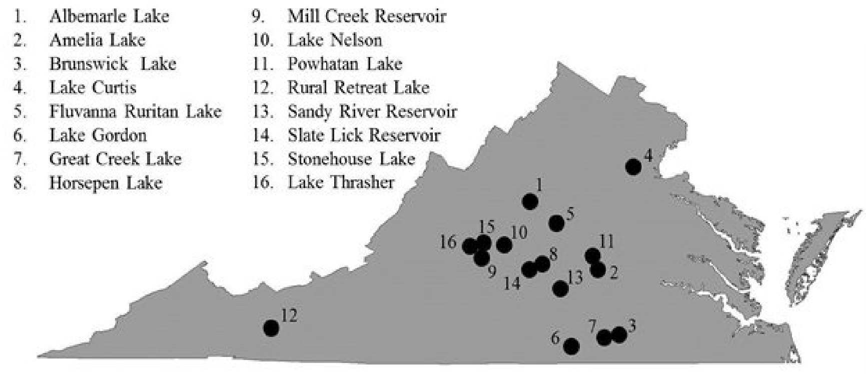

FIGURE 1. Locations of Virginia lakes and reservoirs where water samples for phytoplankton analysis were taken September 12-29, 2013.

unicellular cyanobacteria, and other algal species counted as number of cells per ml. Standard temperature and pH readings of the surface water were taken during each sampling.

RESULTS AND DISCUSSION

The 16 lake locations were centered predominantly in the Piedmont geographic region of Virginia. The Virginia Department of Game and Inland Fisheries indicated 8 of these lakes as eutrophic (Albemarle, Amelia, Curtis, Fluvanna Ruritan, Gordon, Horsepen, Stonehouse, Thrasher), 4 mesotrophic (Brunswick, Mill Creek, Nelson, Rural Retreat), and 1 oligotrophic (Slate), with 3 not designated (Brunswick, Powhatan, Sandy River). Neither of these non-designated lakes possessed high cell counts, and based on their algal composition appeared to be mesotrophic, but further nutrient analysis would be necessary to indicate their trophic status. Fifteen sites varied in size from 4 ha (Slate Creek Reservoir) to 85 ha (Great Creek Lake), with Sandy River Reservoir the largest in area at 299 ha. Surface water temperatures during sampling ranged from 25.5 to 30.5° C (mean 27.1 ° C), and pH ranged from 5.9 to 8.8 (mean 7.6).

The most common populations in these waters were cyanobacteria, chlorophytes, and diatoms. A variety of other taxa were also present, but generally in lower abundance and diversity. They included representative species of euglenophytes, cryptophytes, dinoflagellates, chrysophytes, and raphidophytes. These populations were similar to taxa previously reported by Marshall (2013), plus there were 35 additional taxa not identified in his previous collections (Table 1). In samples from these 16 sites, the chlorophytes included a diverse assemblage represented by several *Scenedesmus* and *Desmodesmus* taxa, plus *Staurastrum* spp., *Crucigenia* spp., *Tetraedron* spp., and *Chlorella* spp. The diatoms were common at each location, but generally not in high abundance during these collections. The exception was *Aulacoseira granulata* v. *angustissima,* with concentrations of 9,720 cells/ml in Amelia Lake. This taxon was

TABLE 1. Additional taxa to be added to phytoplankton recorded by Marshall (2013) in Virginia lakes and reservoirs.

Cyanobacteria
Aphanocapsa nubilum Komárek & Kling
Chroococcus distans (G.M. Smith) Komárkova-Legnerova & Cronberg
Chroococcus prescotti Drouet & Daily
Gomphosphaeria natans Komárek & Hindák
Oscillatoria lacustris (Klebahan) Geitler
Oscillatoria limnetica Lemmermann
Oscillatoria nigra Vaucher
Oscillatoria tenuis C. Agardh ex Gomont
Phormidium splendidum (Gomont) Anagnostidis & Komárek
Synechococcus nidulans (Pringsheim) Komárek & Bourrelly
Synechocystis aquatilis Sauvageau
Woronichinia fusca (Skuja) Komárek
Diatoms
Aulacoseira varians Agardh
Navicula capitata Ehrenberg
Nitzschia palea (Kützing) W. Smith
Synedra acicularis (Kützing) W. Smith
Synedra tenera Agardh
Chlorophytes
Chlorococcum minutum Starr
Desmodesmus hystrix Lagerheim
Scenedesmus acutus Meyen
Schizochlamys gelatinosa A. Braun
Sphaerocystis sp.
Stephanosphaera pluvialis Cohn
Stigeoclonium lubricum (Dillwyn) Kützing
Ulothrix tenuissima Kützing
Ulothrix zonata Kützing
Chlorophyte, Desmidiaceae
Closterium costatum Corda
Closterium sp.
Cosmarium tenue Archer
Cosmarium trilobulatum Reinsch
Xanthidium antilopaeum (Brébisson) Kützing
Chrysophytes
Dinobryon cylindricum Imhoff & Ettl
Dinobryon eurystoma (Lemmermann) Hillard & Asmund
Cryptophyte
Rhodomonas sp.
Dinoflagellate
Katodinium vorticella (Stein) Loeblich II

present throughout the sampling at each site. Other diatoms frequently noted included *Fragilaria crotenensis* and a variety of pennate taxa, plus several cryptophytes (e.g. *Cryptomonas* spp.) and a variety of euglenoids in low abundance, and all previously noted by Marshall (2013). In contrast, the cyanobacteria were generally more abundant than the other categories including having major bloom development in three of the eutrophic lakes (Table 2). These sites and the cyanobacteria bloom producers occurring there were Fluvanna Ruritan Lake (*Jaaginema metaphyticum, Pseudanabaena acicularis*), Lake Gordon (*Cylindrospermopsis philippinensis*, *Glaucospira laxissima*, *Planktolyngbya contorta*, *P. limnetica*), and Lake Thrasher (*Microcystis aeruginosa, Anabaena viguieri*).

Among the cyanobacteria were 4 potential toxin producing species. These taxa, along with their abundance and locations were *Anabaena spiroides* (Lake Amelia; 237 filaments/ml), *Cyclindrospermopsis raciborskii* (lakes Curtis, Fluvanna Ruritan, Thrasher, Sandy River; 60 to 11,520 filaments/ml), *Limnothrix redekei* (Lake Nelson; 1,020 filaments/ml), and *Microcystis aeruginosa* (Lake Thrasher; 25,820 cells/ml). Besides *M. aeruginosa,* other abundant cyanobacteria in Thrasher Lake, were *Anabaena viguieri* (8,640 filaments/ml), *Planktolyngbya contorta* (289 filaments/ml), and *Planktolyngbya limnetica* (290 filaments /ml). The other algal categories were less diverse and typically in low abundance. When present, these algal blooms produced a greenish coloration to the surface water with its intensity increasing with the bloom species abundance. However, during these collections, there were no indications of any harmful effects (e.g fish deaths) associated with any of the occurring bloom concentrations. Of note, numerous potentially harmful algal species have been reported in other water habitats in Virginia. For instance, several of these dominant and bloom producing cyanobacteria were in the low saline (oligohaline) waters of Back Bay Virginia (Marshall (2012), including bloom concentrations of *Microcystis aeruginosa* in the Potomac River (Marshall and Egerton 2009a). Other potential toxin producing dinoflagellates have been noted in Virginia tidal rivers and the Chesapeake Bay ecosystem (Marshall and Egerton 2009b, Marshall et al.2009).

SUMMARY

A diverse assemblage of phytoplankton occurred in this sub-set of 16 Virginia lakes and reservoirs with a similar representation of dominant species and bloom producers to those previously reported in other Virginia freshwater locations by Marshall (2013). The sites included here are impoundments created over the past several decades possessing a range in size, with most at meso- to eutrophic stages of development. The water samples contained a broad representation of chlorophytes, diatoms, and cyanobacteria that included several bloom producing species and 4 potential toxin producers. With these 16 sites, this brings the total of freshwater habitats examined in this phytoplankton survey from 46 to 62 lakes and reservoirs, with a current phytoplankton listing raised to 342 taxa. Since these samples represented few sampling locations at each site and were not taken year-round, the collections are limited in scope, so further sampling will certainly expand the freshwater species list for these and other Virginia lakes and reservoirs; including species of potential toxin producing capability.

There continues to be concern regarding future transitions in the composition of these phytoplankton populations. These changes would accompany any increased

Table 2. Abundance of bloom producing species in lakes Amelia, Gordon, Fluvanna Ruritan, and Thrasher recorded in September 2013.

Amelia Lake	
Aulacoseira granulata v. *angustissima*	8,720 cells/ml
Lake Fluvanna Ruritan	
Pseudanabaena acicularis	15,000 filaments/ml
Jaaginema metaphyticum	11,400 filaments/ml
Lake Gordon	
Cylindrospermopsis philippinensis	7620 filaments/ml
Glaucospira laxissima	2,640 filaments/ml
Planktolyngbya contorta	1,620 filaments/ml
Planktolyngbya limnetica	6,720 filaments/ml
Lake Thrasher	
Microcystis aeruginosa	25,820 cells/ml
Anabaena viguieri	8,640 filaments/ml
Planktolyngbya contorta	289 filaments/ml
Planktolyngbya limnetica	290 filaments/ml

eutrophication at these sites associated with the natural aging of these habitats. This has direct relevancy to the older Virginia lakes and reservoirs where many of the less desirable species (e.g. cyanobacteria) would become more dominant, in contrast to algae generally considered the more desirable flora (e.g. chlorophytes, diatoms) as an oxygen and food source to various fauna in these waters. Projected climate change events would also influence the phytoplankton composition in these waters in a similar fashion (e.g. increased temperatures, rainfall, and nutrient entry, etc.) being more conducive to greater cyanobacteria development over other algae (Carey et al. 2012, Paerl and Paul 2012, Lürling et al. 2013). Thus, in future years, more Virginia lakes and reservoirs are predicted to have an increased presence and dominance of bloom producing taxa (specifically cyanobacteria), which may include many capable of toxin production. These results further support earlier findings by Marshall (2013) of the summer presence of several bloom and toxin producing species in Virginia's lakes and reservoirs.

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