A New Primary Producer Enters the Tidal Freshwater Potomac

Field Observations and Lab Studies of *Lyngbya wollei* in the tidal Occoquan River

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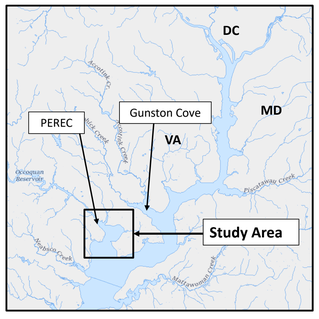
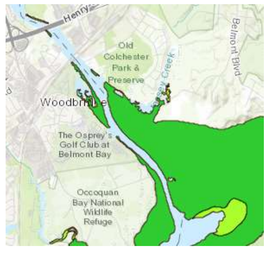
Introduction

For decades the management of the tidal freshwater Potomac River has been focused on decreasing phytoplankton populations and improving water clarity to promote the growth of submersed aquatic vegetation (SAV). This goal was largely achieved, but the resulting improvement in water clarity has resulted in the growth of the benthic cyanobacterium *Lyngbya (Microseira) wollei*. This potentially toxic form has been found in several locations in the tidal Potomac and has developed large populations in some areas, in particular, the tidal Occoquan River. While this organism contributes to primary production in the river, cyanobacteria are regarded as a poor food source for consumer organisms like benthic invertebrates and zooplankton and probably contributes little to the river's food web. Given its ability to produce toxins and its proclivity to break up and drift around including washing up on shore, it poses a hazard to river users and their pets. Studying benthic algae such as *Lyngbya* poses complex sampling and analysis challenges which we have started to tackle and we will report on our results here.

Study Area

The tidal Occoquan River is an embayment of the tidal freshwater Potomac River located a few km downstream of Gunston Cove. Most of the study area is shallow (<2m) and is heavily colonized with a diverse assemblage of SAV (green area below).





SAV Coverage in 2021 from Vims

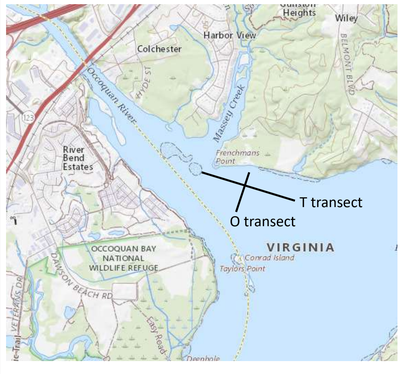
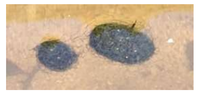


Fig. 1. *Hunting Creek and Vicinity.*.

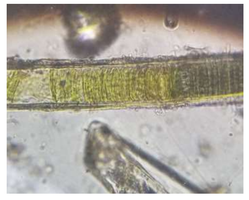
Floating mat composed predominantly of *Lyngbya wollei*

Materials and Methods



Studies of *Lyngbya* were initiated in 2020 by M.S. student Samantha Mohney as part of her thesis work. For this work a ponar grab was used to sample both *Lyngbya* and associated plant material. Sampling was confined to a 30.5 x 30.5 m area delineated within a bed of SAV dominated by *Vallisneria americana*. A grid was established within this study area and three locations were randomly chosen for boat anchorage. At each anchorage three ponar samples were collected from the boat. Samples were processed by sieving the material through a 0.5 mm sieve while removing SAV which was retained for dry weight measurement. Material on the sieve which was mostly *Lyngbya* was then processed for chlorophyll and dry weight analysis. See Mohney (2022) for details.

Ponar sample with individual subsamples obtained by cork borer



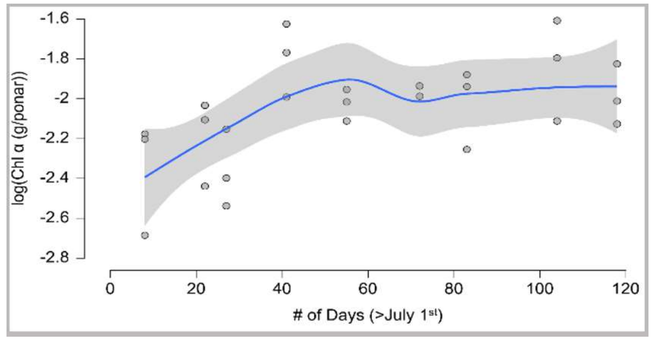
Spring cells were not very healthy looking

Studies were resumed in Spring 2023 by R.C. Jones. In mid summer Hannah Toney joined my lab and we resumed work *Lyngbya*. In 2021 *Lyngbya* was observed to have grown into a sheet covering the bottom of the river. In order to try to capture the early growth of *Lyngbya* we devised a technique of core sampling with a cork borer into intact bottom samples collected by the ponar (left). Techniques were developed for phycocyanin determination (a pigment specific to cyanobacteria) and filament density as well as chlorophyll a and dry and organic weights. The technique proved effective, but *Lyngbya* growth on the sediment surface in 2023 proved slower than expected. In July, we curtailed the transect studies and initiated studies to develop new indicators of growth in grab samples of *Lyngbya*.

Results

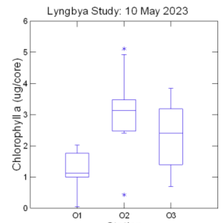
2020 Studies

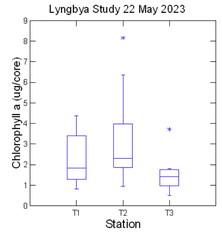
In 2020 studies were delayed until early July due to COVID restrictions on field and lab work. By that time *Lyngbya* was already highly developed on the sediment surface in the study area. However, biomass of Lyngbya continued to increase exponentially through August before stabilizing in September and October. This work was part of Sam Mohney's thesis (Mohney 2022).



2023 Studies

In spring two transects were established: one parallel to shore (T transect) and one perpendicular to shore (O transect). They crossed at the middle so T2=O2. Results of these studies suggested that distance from shore was more important than distance along the shore. However, these springtime samples contained only limited abundances of Lyngbya and the filaments themselves looked unhealthy. Focusing on the smaller cores rather than an entire ponar sample did allow us to take greater care in ensuring that our samples contained only Lyngbya and not extraneous material like plant fragments and detritus.





Starting in July we began sampling mats directly which were starting to find drifting around and in other places to look at other indicators of *Lyngbya* abundance and growth such as phycocyanin concentration, ash-free dry weight, and filament density. We continued using the cork borer to obtain small, easy to clean samples.

	7/5/2023	8/1/2023
Chlorophyll a (ug/core)	41.7	51.4
Dry Weight (mg/core)	5.90	47.7
Ash Free Dry Wt (mg/core)	3.82	34.5
Phycocyanin (ug/core)	580	----
Chl a/AFDW	0.011	0.003
AFDW/DW	0.712	0.698
Phyco/AFDW	0.151	----
Phyco/Chl a	16.2	----

The results of these studies showed that chlorophyll concentrations with solid mats were an order of magnitude or more compared with the sediment surface cores that were obtained in the spring. We also established ash free dry weight and dry weight as reliable indicators when samples were thoroughly cleaned. And we introduced phycocyanin as an independent pigment specific to cyanobacteria.

The ratios shown in the table above are consistent with values reported for these ratios in other algal communities.

Conclusions

A new primary producer, the cyanobacterium *Lyngbya* (*Microseira*) *wollei,* has made its entré into the tidal freshwater Potomac River. Its growth and development have continued to occur for several years making it a significant part of the ecosystem. Much research remains to describe its seasonal growth and development, its overwintering behavior, its spread, and its actual toxicity. We have developed a sampling method that utilizes ponar grabs and subsampling with a cork borer which holds considerable promise, but the various habitats assumed by *Lyngbya* (benthic, drifting mats, attachment to SAV) and their seasonality makes quantitative sampling challenging.

Acknowledgements

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Citations

Mohney, S. 2022. Benthic cyanobacteria production and abundance in the tidal Occoquan River. MS thesis. George Mason University. Fairfax, VA.