Foam Study Summary: Canandaigua Lake

Conducted by Global Aquatic Research | August 2020

Global Aquatic Research (GAR) and the Canandaigua Lake Watershed Association (CLWA) surveyed and sampled lake foam with the help of citizen scientists throughout the late summer and fall of 2019.

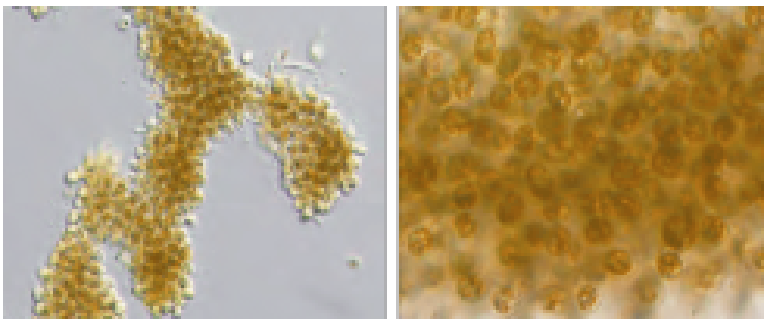
NEW RESEARCH CONDUCTED

- Many chemical analyses were performed on the foam and the results were compared with the chemical signatures of tributary streams, lake water, invasive mussels, plankton, and seaweed, in order to identify the source of the foam.
- Carbon isotope and fatty acid signatures indicate the source of the foam comes from within the lake.
- Very high concentrations of carbon and low concentrations of nitrogen in the foam suggest it is enriched in one type of biological component that is low in nitrogen. This means that invasive mussel proteins are not the source.
- FTIR (fourier-transform infrared spectroscopy), an advanced technique used to identify organic substances, indicated the foam is primarily made of carbohydrates, in particular polysaccharides, which are long chains of sugars. A range of aquatic organisms commonly produces these, but the FTIR signature of the foam was most similar to the phytoplankton sample from the lake.
- All measurements were consistent with Microcystis algae, the cyanobacteria that are responsible for the harmful algal blooms (HABs) and produce the microcystin toxins responsible for beach closures, as the source of these foam-causing polysaccharides.

Large foam accumulation on Canandaigua Lake, 2019.

WHAT'S GOING ON IN THE LAKE?

- Plankton, which include all microscopic plants and animals suspended in the lake water, are filtered by the invasive zebra and quagga mussels. Microcystis cyanobacteria are a poor food source for the mussels. The mussels eat other plankton and spit the cyanobacteria out. Over time this selectively concentrates the cyanobacteria in the water.
- Phosphorous and nitrogen concentrations in the lake support phytoplankton growth, and during the summer when sunlight is abundant, cyanobacteria grow at fast rates.
- Microcystis cyanobacteria release polysaccharides outside of their cells in order to create large colonies and to regulate their environment. These "exopolysaccharides" or "EPSs" are produced in large quantities during phytoplankton blooms and change the chemistry of the surface of the lake.
- Invasive mussels get "sick" when feeding on the cyanobacteria and start producing polysaccharide-rich mucus of their own while recycling and ejecting the cyanobacteria EPSs, exacerbating the problem.
- Over time, these EPSs, which are not very soluble in the water and are stable in the environment, accumulate in the SML (see Foam Facts) and provide the right conditions for foam production. In fact, these types of polysaccharides are used in industries to stabilize foam and create emulsions.



Microcystis aeruginosa, round to oval cells embedded in a mucilaginous matrix made of polysaccharides (USGS 2015)

WHAT CAN WE DO TO PREVENT THIS?

Limit nutrient inputs into the lake. This can help control both cyanobacteria and mussels, which proliferate from abundant phosphorus and nitrogen.

The best ways to reduce nutrients are to:

1. Use less fertilizer
2. Control animal waste and wastewater discharge
3. Reduce erosion
4. Preserve and plant shrubs, trees, and groundcover along tributary streams.

IS THE FOAM SAFE?

- Some foam can concentrate pollutants at much higher levels than in the surrounding environment. This part of the study is ongoing. However, we have found microcystin toxins in the foam at higher concentrations than in nearby lake water, and in a few cases, higher than the NYS Department of Health's recreational limit.
- Our current study included testing for PCBs. Results will be forthcoming.

Foam Facts

- Foam can be naturally formed in lakes when the surface water is mixed by wind and waves and captures air bubbles. Foaming agents, the compounds that cause foam, are not very soluble in water and accumulate in the top 1mm of the lake in what is called the "surface micro-layer" or the "SML."
- Changes in a lake's water chemistry can result in more foam creation and more stable foam that may create noticeable bands in the middle of the lake or accumulate on beaches after it blows to shore.
- The quantity and stability of foam produced on Canandaigua Lake over the last several years hints at underlying changes to the lake's watershed or ecology.

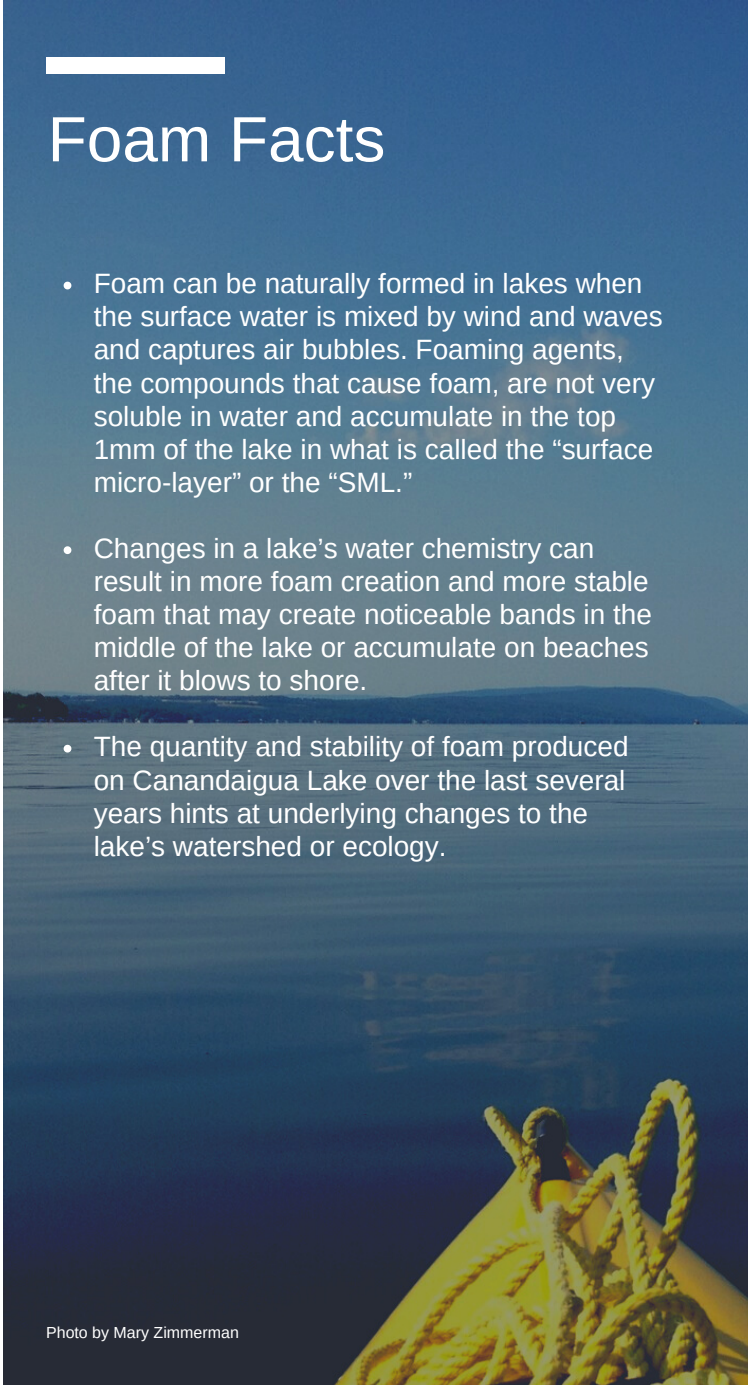


Photo by Mary Zimmerman

NEXT STEPS

Future research should assess the foam's potential to accumulate heavy metals and industrial toxins (including PFASs) in addition to further investigation of microcystin toxins in the foam.

- CLWA and GAR are developing a phase 2 plan to assess 4-season sampling and further testing for pollutants.
- CLWA needs your support to fund this expanded foam research and to support our efforts to improve water quality throughout our watershed.

Please contact CLWA for more information: info@canandaigualakeassoc.org

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Sponsored by Canandaigua Lake Watershed Association.

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