Wine Water

☐ *by Darby Nelson*

Geri and I shoulder our packs and canoe then head down the path to the put-in point at the east end of Beaverhouse Lake, gateway to Quetico Park. After two trips from the car, we launch our canoe into the darkest water I've ever seen. The tip of my paddle disappears in the maroon-brown lake.

"Tea water" to some, "maple syrup water" to others, the water that swallows my paddle is the color of red wine. No matter the name, dark water lakes are common in the Boundary Waters while other lakes in the area are quite clear. That many of the lakes in the bedrock basins of Quetico/ Superior have beautifully clear water is no surprise. The landscape of bare rock and thin soil simply doesn't provide lakes with enough nutrients to sustain the large algae and plankton populations which reduce water clarity elsewhere. The real puzzle is why *all* the lakes in canoe country are not crystal clear. These dark water lakes have captured my curiosity.

What is the material that darkens lakes, and where does it come from? As a gardener and backyard composter, I should have understood the answer to that question long before I did. Piles of leaves and grass clippings rot over time, becoming rich dark compost. The rotting process produces large organic molecules called humates, the dark material in compost. The humus of forest floors is well named. The same process occurs in wet environments, as I accidentally discovered by leaving the weeds pulled from my garden in a pail. When I a returned weeks later, after several rains, the plants were black mush sitting in a dark liquid; the same humic material that's in compost and colors dark water lakes.

Though humates enter lakes through runoff and seepage from forest soils, wetlands are especially rich sources of the dark molecules. The relative concentration of dissolved humates typically determines the density of color in bedrock basin lakes.

A short paddle puts us on Quetico Lake which, though colored, is not nearly as dark as the wine water back at our Beaverhouse launch. A bright sun beats down, and Geri reaches for the sunscreen. I dislike greasing up with the stuff, but it is wise to do so. Ultra-violet radiation can seriously damage DNA with tragic consequences. UV also penetrates lake surfaces and, strange as it sounds, can harm the DNA of aquatic life just as it does ours.

As many of us produce melanin and become naturally tan when exposed to UV, some water fleas, those tiny crustaceans eaten by ciscoes which are then eaten in turn by lake trout, can do the same. The black pigment in frog eggs is likely also a protective adaptation against UV damage.

Unfortunately for the melanin-making water fleas, the pigment makes them more visible and so increases their mortality rate through fish predation. Fry in UV or die in a fish stomach, that's the choice.

UV can also harm fish larvae. Survival of larval bluegills drops as UV exposure increases. Studies show that both bluegills and perch take UV radiation into account when choosing nest sites. Overhanging trees can significantly reduce UV exposure along shore where most bluegills nest. Perch in clear lakes are forced to spawn in deeper, colder water to avoid UV damage. Cisco larvae in clear water lakes also attempt to avoid UV.

Humates are also part of the UV story. Those molecules absorb UV much like sunscreen does on a paddler's skin. In wine-colored lakes, humates absorb most of the damaging radiation within the top few inches of water, enabling perch to spawn in shallower, warmer water—speeding fish development by several weeks.

As we paddle slowly east down Quetico, I think of the lake trout I've caught on this lake. Today the warm surface waters of midsummer have driven trout into the cold depths, far removed from the surface world and wine-colored molecules; that's what you might think.

It surprised me to learn that humates can have a significant impact on the lives of trout. Humates capture energy from ultra-violet and other wavelengths, then convert much of it into heat that warms the lake's surface. That turns out to be very good news for trout. By retaining warmth near the surface, a larger volume of the lake remains cold enough in the summer to satisfy trout. In lakes with little color, just the opposite happens. With light and UV penetrating deeper, less heat is retained at the surface and more is dispersed at greater depths. This reduces the volume of cold water that trout prefer.

Canadian studies have discovered that in clear Ontario lakes, UV penetration extends the warm water zone three to six feet deeper than it would be were the lake water colored. That three to six foot layer of water can represent a significant loss of habitat for lake trout in midsummer. By determining the proportion of lake depth that is cold, humates control the quantity of summer habitat for trout. These effects are much more noticeable in smaller, shallower lakes.

The day has become sultry as we stop for lunch on a point. I take a quick dip in the lake as Geri pulls rye crisps, cheese and raisins from our day pack. While the cold water feels good today, on most wilderness trips I'd prefer warmer water to swim in. As I towel off it occurs to me that thanks to the same humates that maximize lake trout habitat by retaining heat at the surface, they would also make wine water lakes warmer for swimming than clear water lakes of the same *the* BOUNDARY WATERS JOURNAL

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Publisher/Editor

size. I need to remember that.

We continue our leisurely pace and find a campsite for the night. My thoughts turn to fish for supper. Since lake trout are now in deep water, I figure it is simpler to try for bass. Besides, the smaller bass would almost certainly have lower mercury levels than would mature predator trout. Though studies show trout from large deep lakes like Quetico typically have lower mercury concentrations than trout from smaller, shallower and particularly darker water lakes. Sure enough, those humates play an important role in the mercury story too.

Chemists have discovered that mercury is powerfully drawn to humate molecules. That explains the strong correlation between degree of darkness of lake water and the mercury concentration in fish. Bogs and other wetlands are not only the major source of humates in shield lake watersheds, they also support the bacteria that converts mercury in the form unhealthy for the likes of people, otters and loons. Those dark colored molecules have a much greater impact on bedrock lake ecology than I ever imagined.

I consider the walk from our car to our launch point earlier in the day. A small shallow stream

PAUL SUNDBERG

Lakes draining lots of swamps, bogs and beaver ponds collect tannic acid and appear dark wine colored. (Lake Two)

flows across the trail moving from one wetland then crossing over into another before reaching the tiny inlet and delivering itself into Beaverhouse Lake. No wonder the water at our launch was so dark.

Fishing rod in hand, I walk to the shore to a rock outcrop positioned by a weed bed. The plants are sparsely scattered, typical of nutrient-poor bedrock lakes. I cast and reel. Nothing strikes. Given the low productivity of these sterile lakes, fishing success in places like this is due more to limited fishing pressure than the productivity of the waters.

I cast again. Still no luck, and a thought comes to mind. The dark humate molecules, by absorbing UV and visible light, must also reduce fish productivity. Photosynthesis is the key to a robust food chain. By reducing light penetration, humates retard plant growth and so diminish food all the way up the food chain, reducing the number and size of fish available to my hook. But since humates are such large organic molecules it's reasonable to expect creatures like bacteria and protozoans to feed on them and so enrich the food chain, compensating a bit for having hindered photosynthesis. One might logically ask if there is any part of bedrock lake ecology not touched by those molecules that make water look like wine.

I continue to cast and continue to catch nothing, so I return to camp and sheepishly tell Geri we eat meatless spaghetti tonight. I can't help but wonder if my failure at fishing has more to do with a mind focused on humates than on fish.

During the night Geri experiences intense pain. By morning her condition is serious. We have no choice. We break camp quickly and paddle/portage as fast as we can back to the car and Highway 11 then to the clinic in International Falls. We arrive just before it closes for the day. The doctor orders tests and gives Geri medicine that calms the pain. The doctor says to hover in town for a few days, and if no further attacks occur we can consider returning to Quetico.

Two days later we launch once again onto the wine-colored water of Beaverhouse Lake. □