Transect Three

Colton Poore

"Fifteen minutes to station. Fifteen minutes to station." A voice from the captain comes over the intercom.

Joe Connolly from the Cornell Biological Field Station slips on his life vest, dons his hard hat, and puts on his steel-toed boots—required protective equipment for going onto the back deck of the Lake Guardian, the EPA's research vessel on the Great Lakes. Every year, scientists aboard the Lake Guardian conduct intensive sampling on a different Great Lake. This year is Lake Ontario. Last year was Lake Huron.

In the wet lab, Audrey Stanton and Allison Croak, summer interns at the field station, are already prepared. Bright-eyed at 5 AM after a cup of coffee, they are talking about their plan for the upcoming sampling station, the second of the day. We will have four more over the course of our shift. The samples we collect at each station vary, but this one is going to be busy: two zooplankton nets, two closing nets, a larval fish tow, chlorophyll, and a Secchi disk.

I am getting ready in the wet lab too, only I will be on the Rosette deck, deploying the Rosette sampler and collecting water from it when it returns. I am with four other scientists from the EPA. Together we represent CSMI, the Cooperative Science and Monitoring Initiative on the Great Lakes. We are discussing our plan of attack, making jokes, and trying to wake ourselves up—working from 4 AM to 4 PM for several consecutive days has made strong coffee our friend.

The EPA R/V Lake Guardian. Our office for the week.

Today is Thursday. We started on Monday. In one and a half days we will be back in Rochester.

Five minutes to station. I put the collecting bottles—brown to protect the chlorophyll pigments in the water—by the door. Up front, Audrey has grabbed the data collection sheet for this station, and Allison has grabbed the bucket with the sample bottles.

Finally, the boat comes to a halt. It is time.

I grab the bottles, open the hatch, and step outside. I take a moment to look out at the orange glow of the growing sunrise over Lake Ontario. Then up the steps and onto the Rosette deck. Allison, Audrey, and Joe have just done the same on the back deck. They are preparing their zooplankton nets for the water.

By now, I am used to the routine. I place the bottles in the corner of the deck and wait with one of the EPA scientists for the marine technician to give us the thumbs up. Then, one of us plugs the probe into the Rosette.

Derek Ager from GLNPO and Aisha Sexton-Sims from EPA Region 2 deploying the Rosette sampler

The Rosette sampler is an impressive piece of equipment. Twelve grey cylindrical bottles are arranged in a circle around a central apparatus. The entire contraption is held within a cage of white bars and is attached to a wire rope so that it can be raised and lowered in the water. It measures things like water depth and temperature, dissolved oxygen levels, and levels of chlorophyll-a, a pigment that is essential for photosynthesis. The twelve bottles are closed right now. When the Rosette is in the water, the marine technician can open one at a time in order to collect water samples from different depths in the lake.

After plugging it in, we return the marine tech's thumbs up. We guide the Rosette sampler as the marine tech raises it on the winch. We watch as it moves over the side of the boat, lowers into the water, and disappears into the depths. Now we will go back inside and gather around a computer screen, tracking a live display of the Rosette's descent into the lake.

From my perch on the Rosette deck, I can see Joe attaching a net to a cable on the back deck. That is the first of the four zooplankton nets; it will descend 20 meters and then return to the surface. The other three will go deeper, but they must wait for the Rosette to resurface so as not to interfere with it. The nets will catch the zooplankton—tiny animals in the water that are an important energy source in the food web of the lake.

By now, I am at the computer with the other scientists. As the Rosette lowers, four lines descend on the screen. A red one charts the temperature, a green one represents chlorophyll-a levels, blue is dissolved oxygen, and yellow is beam attenuation—a measurement of how much light is absorbed by the surrounding water.

"No MEP on this one," says Anne Cotter, an EPA researcher from the Office of Research and Development. "Shallow epilimnion."

What we see as the Rosette descends. Red is for temperature, green for chlorophyll, blue for dissolved oxygen, and yellow for beam attenuation.

I agree. A few days ago I found myself overwhelmed with newfangled terms like MEP, LEP, and DCL, but I have picked up knowledge quickly. In the summer, lakes often become stratified into three distinct layers. The top layer, located near the surface where the sunlight reaches, has relatively warm and stable temperatures. It is known as the epilimnion. At some depth, the sunlight is less accessible, and the temperature begins to drop. This layer of decreasing temperature is known as the metalimnion or the thermocline. After the thermocline, the water temperature begins to stabilize again. This section of stable, cold water, where minimal amounts of light penetrate, is the hypolimnion. It extends from the end of the thermocline to the bottom of the lake. The relative depths of these three layers can fluctuate throughout the season. They can even change over the course of the day.

The MEP, or middle-epilimnion, is partway down the epilimnion. The LEP, or lower-epilimnion, marks the boundary between the epilimnion and the beginning of the thermocline. We are also collecting water from the surface, so we will be able to get a good picture of the epilimnion. But since it is early in the summer, the epilimnion is often shallow. It is not deep enough to have a well defined upper, middle, and lower section, which is why this station has no MEP.

Now, Anne is pointing to a spike in the green line (chlorophyll-a) on the screen. She playfully quarrels with Derek Ager, another EPA scientist. He represents the Great Lakes National Program Office, or as we call it, GLNPO. She thinks that that spike in the line, the DCL or deep chlorophyll layer, is at 13 meters below the surface. He thinks it's at 14.

Although it would seem like the most chlorophyll-a, the photosynthetic pigment, would be close to the surface of the water where there is the most amount of sunlight, in many aquatic ecosystems the peak is actually deeper in the water column. Most often, the peak is in the thermocline—the middle layer of the lake. Even though the temperature fluctuates in the thermocline, it is also the spot in the lake that has a lot of the nutrients that are required for photosynthesis. There may be less available sunlight, but photosynthetic organisms have a greater access to nutrients than they would at the surface.

This is evident in the green line's prominent right-spike on the computer screen in front of us, the exact depth of which is the subject of light-hearted debate between Anne and Derek. Both sides refuse to budge from their chosen depths.

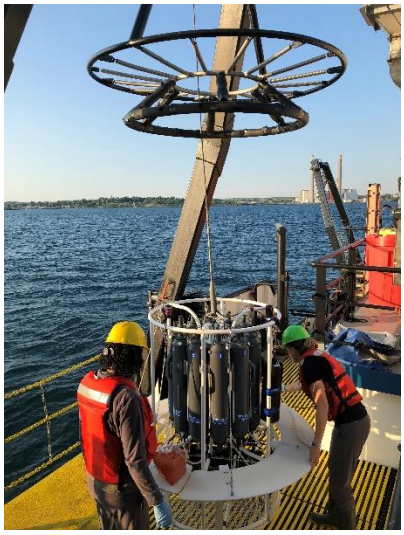
The deadlock is only broken when a marine tech comes through over the speaker. "So it looks like we got a DCL at 13, is that right?"

Anne's face lights up. Triumphantly, she responds, "Yep. That's what I was looking at too." She turns to Derek, shaking his head, and consoles him: "Better luck next time." They are one for one on the day so far—Derek had the winning depth at the last station.

Shaking it off, Derek gives the rest of the depths to the marine tech that we want sampled: surface, LEP, DCL, and bottom, known as B2 or B-. We see on the screen as the marine tech remotely fills the bottles with water from the spots we requested. Usually two bottles are filled at each depth we want in case one of the bottles fails to fire correctly.

It takes a bit of time for the Rosette to resurface after filling the bottles; the lake is over 100 meters deep at this station. But when it does—we track its rising depth on the graph—we put back on our protective gear, adding a pair of nitrile gloves to prevent water contamination.

Out the hatch and up the stairs. We watch as the Rosette rises out of the water and comes over the side of the ship. As it lowers onto the ship, we put our hands on the white bars in order to guide it into its container. Once secured, we unplug the probe, grab our collecting bottles, and start to fill. The grey bottles on the Rosette are numbered from one to twelve. We look up to where the marine tech has given us a cheat sheet, writing which water depth each bottle contains on a whiteboard—bottles one and two are B2 (hypolimnion), for example. SRF for surface. LEP for lower-epilimnion. No MEP on this one. Got it.



Aisha Sexton-Sims from EPA Region 2 and Anne Opseth from the Office of Research and Development collecting water samples.

We grab the brown bottles with labels that match the ones on the board, navigate to the corresponding cylinder on the Rosette, and after triple-rinsing the bottles with the sample water to prevent cross-contamination, we fill.

While I fill, I see Joe on the back deck. He loads the second zooplankton net onto the cable and sends it down. This one is going down 100 meters before coming back up. The third one will go down

100 meters and come up to 50 meters, at which point Joe will attach a messenger to the cable that will close the net at 50. Likewise, the fourth net will descend 50 meters and come up to 20 before it is closed. From these nets, Joe will get a snapshot of the lake's zooplankton population, and he will be able to observe how that population differs in composition at various depths in the lake.

We are about halfway done filling our bottles. Allison helps to pull the zooplankton net out of the water while Joe rinses it with a hose. He is making sure that all the zooplankton end up in the collection basket, called a cod end, at the bottom of the net. Then he disconnects the cod end from the net and hands it to Audrey. She will rinse the contents of the cod end into a sample bottle with as little water as possible so she can preserve it in ethanol. That way, the samples will last long enough for Joe to examine them at the field station back on land.

I do not get to see them deploy the last two nets, nor do I see them drop the Secchi disk (a piece of equipment used to measure water clarity—simply drop it into the water until it is no longer visible and record that depth). Instead, once we have finished getting water, I take the bottles inside to the onboard biology lab. I close the door behind me, turn off the regular lights, and turn on a set of green lights. These green lights protect the chlorophyll in the sample bottles from being damaged. I am going to start filtering the water samples to collect the chlorophyll. It takes a bit of time, so I get started right away.

I take a constant volume of water from each of the sample bottles and pour them into their own beakers. The beakers are magnetically attached to a vacuum filtration manifold. Once filled, I turn on the suction for each beaker in turn. The water slowly passes through filter paper and from there into a waste beaker. The filter paper catches the chlorophyll in the sample. I will carefully fold the paper and put it into a tube that is labeled with the correct depth of the sample. Once the filtration is finished, I will wrap all the tubes in aluminum foil, place them in a plastic bag, and store them in the freezer for preservation.

While the water is filtering, Audrey comes in the lab with the zooplankton samples.

"The tucker trawl in?" I ask.

"Yup. It just went down." That means we only have a few more minutes until the boat shoves off again for the next station.

The tucker trawl is a behemoth of a net, dwarfing the other zooplankton nets. We use it to catch larval fish. It takes three or four people to help the marine tech deploy it, making sure it enters the water smoothly and that no wires catch on any equipment. The tucker trawl stays down in the water for four to five minutes before resurfacing.

Audrey, Joe, and Derek deploying the tucker trawl.

As I oversee the filtration, the boat begins to move again. That means the tucker trawl has come out of the water—larval fish were the last sample to collect at this station. Once out of the water, Joe has rinsed it with a hose, removed the cod end, and emptied the contents into a sample bottle for preservation.

Soon, Joe and Allison make their way into the lab.

"Thirty-five minutes to the next station," Allison calls out.

"What's the next station number? I'll start labeling," Audrey says.

A lot of things to do and not much time to do them. We have samples to process and preserve. Labels to write. Data sheets to complete. I myself have several more samples of water to filter. Hopefully there will be time left to get in a quick bite for breakfast before the next station.

We have improved with each shift. Now, like a well-oiled machine, we glide comfortably by one another. We pass tape, scissors, markers, bottles of de-ionized water. Audrey and Allison go in and out of the bio lab to get things from the wet lab while Joe sieves the larval fish sample to prepare for preservation.

Soon enough, all of the samples are preserved with a bit of time to spare. Joe, Allison, and Audrey have gone to grab a bit of breakfast. I am waiting on my last sample to finish filtering. When it does, I store the tubes of chlorophyll, prepare the filtration system with a new set of filter paper, dump the wastewater onto the Rosette deck, dump the filtered water down the sink, and prepare my next set of tubes.

There is time for me to grab breakfast too. I scarf down some yogurt, toast a slice of bread, and steep a mug of tea. I take some time to think about the way ahead. We are making our way across the third of four transects—lines stretching from one shore of the lake to the other along which stations are located where we collect samples.

Then, back to port and to the field station to analyze the samples. With the data we are collecting, we will gain insight into the food web of Lake Ontario. In particular, we will learn about the lower food web—the zooplankton and the organisms that they feed on. We will examine their population dynamics, where they orient themselves in the water column, and how they migrate throughout the day. The raw data we collect here will help us understand a lake so large that I continue to mistake it for an ocean.

"Fifteen minutes to station. Fifteen minutes to station." My reverie is cut short. I finish my tea and make my way back to the wet lab. Joe is already wearing his life vest, hard hat, and boots. He, Allison, and Audrey are discussing the next station. Once more, I join the EPA scientists.

And then we wait. For the boat to stop, and for us to start again.

Four stations left.