Fall 2021

UPSTREAM

News from Itasca Biological Station and Laboratories

Photo: Jonathan Schilling

The Train Wrecker fungus thrives on a fallen portion of the well-known white pine, formerly recognized as Minnesota's tallest.

Life on logs

The loss of Minnesota's largest white pine opens opportunities for researchers to talk about its afterlife, an often ignored, yet rich chapter of its story.

Clipboards, vials and cameras in hand, a small team mills around the carnage as steam rises from recent rain. They place specimens into bags, and rather than shake their heads at the loss, they marvel at what's to come. Although a couple of suspects come to mind, questions remain. Who was to blame for this?

While all the makings of a crime scene, 911 wasn't called.

Instead, a newly penned notebook entry details a 41-foot-long section of a white pine — formerly Minnesota's largest — brought down by a strong summer storm in 2019. In the widest section, even two people can't reach around for a hug.

IBSL Director Jonathan Schilling, who is a professor in Plant and Microbial Biology, studies wood rot and was just a few miles away during the storm. News of the toppled tree spread fast and Itasca State Park staff called Schilling to alert him. Schilling and lab members — including undergraduate researcher Lauren Otolski and lab technician Molly Moran — headed over to the tree. The team collected samples that morning and frequently returned to collect more.

"One way or another, every tree is going to die," says Schilling. "I'm fascinated by what happens when that tree hits the ground. The microbial battles that play out and dictate what happens next have massive implications."

Uncertain afterlife

When the white pine segment hit the forest floor, it joined a slew of other logs, stumps and branches. These woody fragments make up 80% of the total carbon that comes from plants. Fungi and other decomposers feast on these woody delicacies, and different fungi specialize in breaking down different structures. Sometimes, carbon is released into the atmosphere and other times it is sequestered in the soil.

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Itasca Biological Station and Laboratories

University of Minnesota

DIRECTOR'S MESSAGE

Greetings from Itasca!

I hope this note from the North finds you well. We had quite a ride at the Station this Summer. It feels like we have been on a whitewater canoeing trip, and that we finally made it to flatwater. We already hear rapids around the corner for 2022 — new users are scheduled, and it looks busy.

This year was hard. Last November, skyrocketing COVID case rates promised a quiet 2021. Instead of quiet quarantine, we got a vaccine, we lifted restrictions, and we took on activity without the staffing we needed. It makes me tired thinking about this year, and I am grateful that we hung on.

But as I sit on flatwater, listening around the corner, I will report two things that make me keep paddling. First, we rebooted Itasca this year with a new organizational chart and two key new hires coming in 2022. We will have a strategic planning effort in 2022, and I will not be shy here in saying it would be a targeted moment to invest as donors and make a lasting difference. We are about to push forward.

Second, growth at Itasca Station is across the board. There is a reason we hear a roar around the corner. We had to cap enrollment at 30% of capacity for field courses, turning students away, yet we still had our highest enrollment in 10 years. We had a cumbersome Covid "Sunrise" research process, and we still tripled the research permits of 5 years ago. And we kept our engagement promises, being a reliable partner with the State Park, local community, and Indigenous collaborators amidst uncertainty and concern.

Itasca is finding a good line downstream. Enjoy Upstream!

Jonathan Schilling
Director, Itasca Biological Station and Laboratories

First fieldwork foray

White Earth & Itasca (WE&I) Internship Program continues for the third season.

A paid three-week scientific field study internship, the program pairs a White Earth area high school student with a University of Minnesota graduate student.

Alyssa Anderson, the 2021 WE&I intern and recent Waubun High School graduate, worked with Hailey Sauer in June. Sauer is a graduate student with Trinity Hamilton, an associate professor in Plant and Microbial Biology. The lab research focuses on microbial photosynthesis and global biogeochemical cycles.

The program is currently funded by a generous donation in the American Indian Fund in the College of Biological Sciences at the University of Minnesota. Learn more about Anderson's experience at z.umn.edu/WEI-21.
—*Rebecca Dallinger, Project Liaison*

Photos: Rebecca Dallinger

(Top) Alyssa Anderson holds up a sample collected in a stream between Elk Lake and Lake Itasca. (Left) Hailey Sauer demonstrates a technique to Waubun Science teacher John Short and others. (From left to right) Colin Adams (2019 WE&I intern), Jonathan Schilling, John Short, Hailey Sauer, Alyssa Anderson.

Setting the stage

Researchers deploy buoys and teams to collect expansive data sets, and anticipate more research acts to come.

Photos: Claire Wilson

Peter Kennedy is caught marking 1 of the 35,000 trees and shrubs in a new monitoring plot in Itasca State Park.

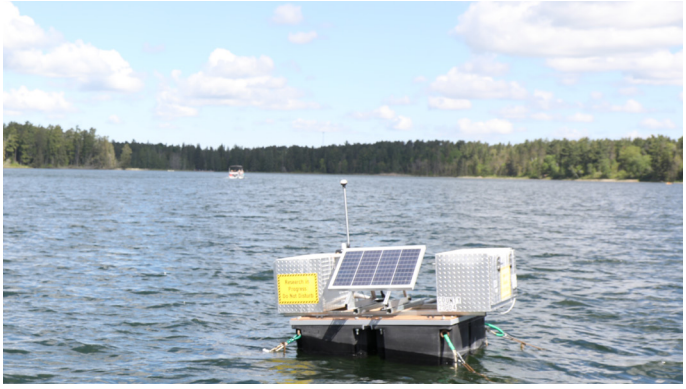
It's a ... buoy!

From the shores of Lake Itasca, the blob on the horizon might be mistaken for an abandoned watercraft. State Park staff did just that earlier this year.

Up close, the blob morphs into a buoy, equipped with bells, whistles and adorned with bird poop. It's equipped with instrumentation that captures conditions in the lake at different depths. The metrics include oxygen, temperature and chlorophyll content, which is helpful in predicting and monitoring for algal blooms.

Technical hiccups and pandemic-related challenges delayed the buoy's debut, but this summer researchers, led by Ecology, Evolution and Behavior Professor James Cotner, fine-tuned the buoy. The number of research questions to come — and engagement opportunities — are numerous.

"It presents a rich opportunity to engage Itasca State Park visitors," says Lesley Knoll, IBSL's Associate Director. "Those who fish want to know about oxygen availability at different depths in the lake and our team is working to find a way to effectively share readings with people."



The 40-acre wood

Coniferous and deciduous forests meet in Itasca State Park. Coniferous forests — comprised of trees with needles — are hallmarks on the northern Minnesota landscape. However, with the warming climate, the "creep" of broad-leaved deciduous trees north continues. Peter Kennedy, a professor in the College of Biological Sciences, is leading an effort to mark trees and track changes.

"By establishing this as a permanent set of tagged trees, we can watch what's happening in the overstory and understory. We're hopeful that this plot becomes a sandbox for collaborators at Itasca and beyond," says Kennedy.

This plot, just a few miles from the station, is now the most well-marked woods in the state. Trees and shrubs with stems wider than a ballpoint pen are marked, measured, and their exact locations within the forest are mapped. Currently, the count stands at 35,000 plants. Come next year, the plot will formally join a network of similar plots around the globe, when data hits the web. —*Claire Wilson*

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Photo: Jonathan Schilling

A white pine standing off Wilderness Drive, formerly known as Minnesota's tallest.

"One way or another, every tree is going to die. I'm fascinated by what happens when that tree hits the ground. What microbes are at play in the decay process has massive implications."

— Jonathan Schilling, professor in Plant and Microbial Biology and Director of IBSL

(Continued from page 1)

Despite the prevalence of woody material, it was long ignored in climate models because all evidence showed it's breakdown was slow, relative to other processes that release carbon to the atmosphere. However, in the past decade researchers have learned more about fungi driving decomposition. It turns out that the rate of decomposition isn't as predictable, and neither is the carbon's ultimate fate.

Brown rot fungi and white rot fungi are the two primary players in wood rot and key culprits of what brought down the white pine. Their diets are different and the "waste" they leave behind can either head to the soil or the atmosphere.

If brown rot fungi made its home on the white pine, about a quarter of the decomposing white pine would end up in the soil off Wilderness Drive. In years to come, hikers would meet new plants nourished, in part, by the former giant.

If, on the other hand, researchers discovered white rot fungi on the white pine, the "waste" products from the fungi's meal would instead be released as a gas and float into Wilderness Drive's canopy — and beyond.

"A key uncertainty for climate models is the type of fungus responsible for the decay. If we become a 'white rot world', all indications are that more carbon is going to end up in the atmosphere rather than sequestered in the soil," says Schilling.

Beyond logs

Researchers used both long-standing and relatively new techniques to sort out what fungus brought down the beloved white pine. They tested the density and chemistry of the wood (Schilling calls this "crime scene" investigation) and sequenced DNA (the "criminal" investigation).

Ultimately, they identified a brown rot fungus known as "The Train Wrecker" — named for its knack of degrading railroad ties — as responsible for weakening the tree's trunk to a snapping point.

For Schilling and lab members, the white pine's loss and thriving fungal life to follow opened up new opportunities to engage with park visitors. Schilling recently led a walk on the site as part of Itasca State Park's Science in Nature series detailing the investigative work on the white pine. State Park staff are interested in building out permanent signage on the site.

Paying more attention to life on logs — and what it means for climate models — has broad implications. For one, planting trees is a go-to solution for offsetting carbon emissions. However, this doesn't take into account a tree's afterlife.

"We need to know the balance of rot types and what might make it tip," says Schilling. "The tease of (planting) trees to offset our emissions is very popular right now, but there is a Train Wrecker out there just waiting to derail it." — *Claire Wilson*

"IN BLOOM"

Tamaracks

This conifer joins the chorus of hardwoods to celebrate the changing season.

New full-time residents on campus

Eric Sather wears many hats to keep station life moving smoothly.

After three years working on staff, Eric Sather recently moved into a new position as facilities lead. We recently caught up with him to learn more about his role at the station.

What do you do?

I'm responsible for leading long-term ground and infrastructure plans, overseeing a wide variety of projects and managing seasonal staff, including our kitchen and housekeeping crew. Given we're currently understaffed, I'm doing a handful of groundskeeping tasks as well. From mowing to fixing leaky sinks, everyday is different. We are in the process of hiring positions back and I'm eager to welcome new hands to the team.

What is unique about this position?

In late spring, I transitioned to this role and that meant moving on campus into the residence cabin with my family year-round.

What's on the horizon?

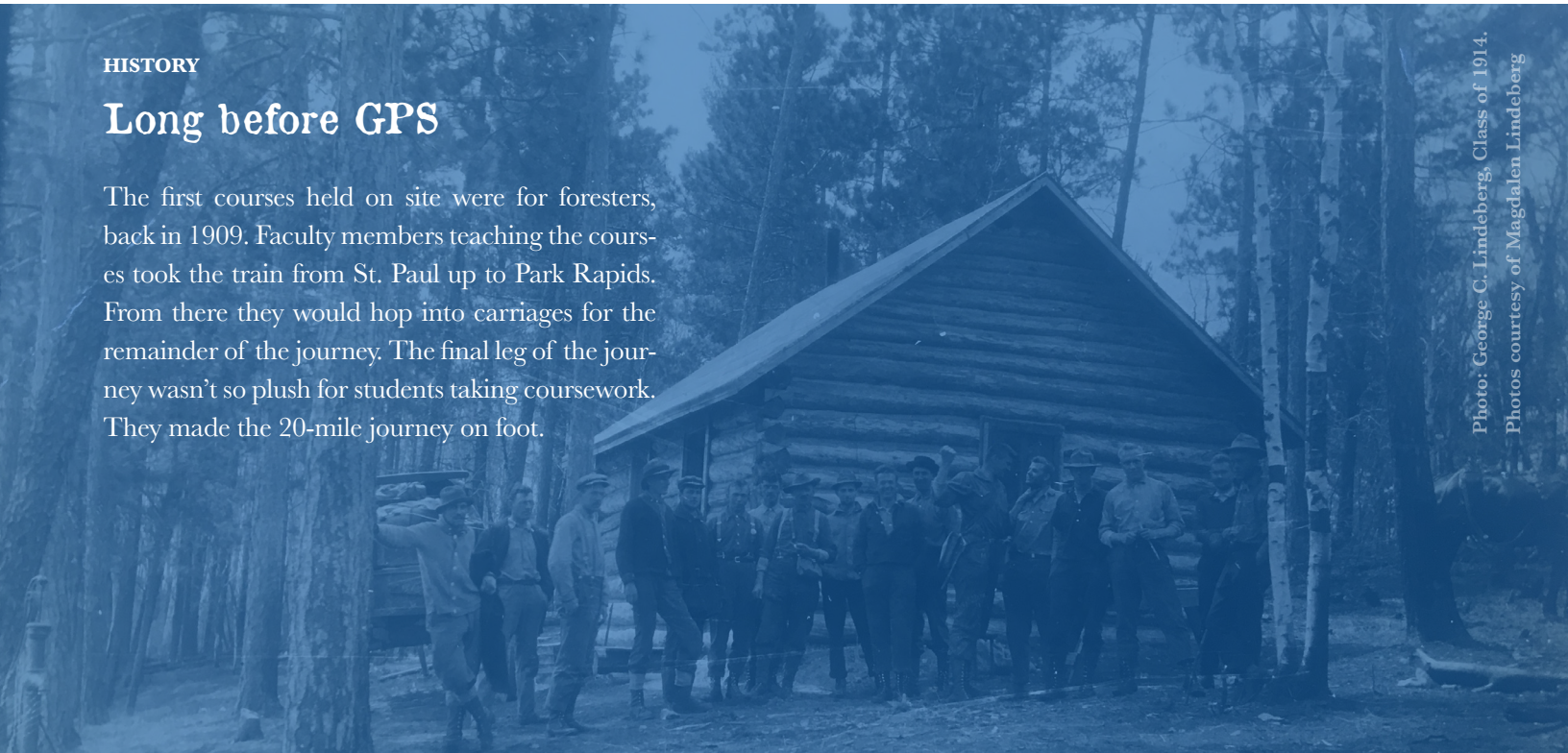
A high priority item in the coming years is to ensure that our facilities are handicap accessible. This means updating pathways, building entrances and making changes to a handful of cabins. These projects don't all have established timelines as we have to await funding, but they are on the forefront of my mind.

What do you value about being on the team?

I am constantly impressed by how passionate and professional my colleagues are. We really feel a sense of ownership and it shows in our work.

What's a good day on the job?

It's always a great feeling when we welcome a big group to campus and our phones don't ring. That means there aren't any issues. My goal is that our users can arrive and seamlessly start their work without running into a roadblock. I take great pride in helping make that happen.



HISTORY

Long before GPS

The first courses held on site were for foresters, back in 1909. Faculty members teaching the courses took the train from St. Paul up to Park Rapids. From there they would hop into carriages for the remainder of the journey. The final leg of the journey wasn't so plush for students taking coursework. They made the 20-mile journey on foot.

Photo: George C. Lindeberg, Class of 1914. Photos courtesy of Magdalen Lindeberg

Perspective: from the field

Graduate student shares their experiences working up north.

View of Lake Mary from Wilderness Drive.

Dragonflies are well known for their superb hunting skills and their long distance migrations. How do they do what they do? The fact that they have evolved large prominent eyes is a dead give-away. One aspect of their fascinating biology is those large eyes that occupy most of their heads. Dragonflies use their sophisticated visual systems to chase and capture prey in mid-air.

Some dragonflies have eyes that merge at the top, while others have eyes that are separated. This latter — less well studied — group includes the many species of clubtails found at Itasca State Park.

I study how different eye morphologies help them see their prey when they hunt. This will provide insight into the multiple paths taken by dragonfly evolution. Small problem, not many people have worked with adult clubtails. We have many unknowns ahead, but that's what makes science exciting. Here's a peek into our time up north.

May 25 | Day 2

Dragonfly tent up, cameras good to go, nets raised high. But no dragonflies.

May 27 | Day 4

Sandstorm from two days ago sent the temperatures plummeting. There are some dragonflies around. No clubtails.

Driving around Wilderness Drive, keeping our eyes peeled, we're entertained by Miji Radio, transmitting from the White Earth Reservation not far away. A curious sight on Lake Mary. From the road we saw dragonflies flying from the lake and into the woods. Clubtails. All freshly emerged Dusky Clubtails.

May 30 | Day 7

You don't fully appreciate the effect a beaver dam has on an ecosystem until you've had to navigate on in a canoe.

Crawling out of the water, up the reeds was yet another clubtail species. Green and much larger than the dusky clubtail. Consulting Dragonflies of the North Woods by Kurt Mead, this beauty seems to be a Rusty Snaketail.

May 31 | Day 8

Finally! The mass emergence at Lake Itasca.

Collected more dusky clubtails, and introduced them to the dusky clubtails from Lake Mary. We were hoping the tent would fool them into thinking they were outside, so we could get some good videos of them hunting inside. Turns out, they're smart enough to be stressed about being in a tent even if it's walls are just mesh. How to observe the natural behavior of a dragonfly without losing it. Leash it, of course. It's fiddly work, tying a fishing line to a dragonfly abdomen, but it does the job.

June 8 | Day 16

Wrapping up. The weather and the whims of the dragonflies kept us on our toes, but we adapted. With tweaks to the originally planned experiment, we even managed to collect some good videos, to be analyzed when we get back in a couple of days. Looks like the last few days will be all about collecting. For the nymphs, we once again waded into the headwaters. One passerby asked us if we were collecting gold. I wish. Not far downstream, native leaders and environmental activists have gathered to try and stop Line 3. I wonder if drilling fluids and oil flow upstream.

— *Siddhant Pusdekar*

Photos: Claire Wilson

Siddhant Pusdekar and labmate David Munkvold (bottom right photo) set up high-speed cameras to capture dragonflies on the hunt.

About the author

Siddhant Pusdekar is a Ph.D. Candidate in Ecology, Evolution and Behavior Program at the College of Biological Sciences. His research interests are animal behavior and evolution. His science communication interests lie in telling stories of science as it interacts with the lives of people.

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GLIMMERS OF NEAR-NORMAL

Summer and fall still didn't look "normal" at the station, but students and faculty munching on food at picnic tables was one of the many hopeful and magical moments.