Spring 2022

UPSTREAM

News from Itasca Biological Station and Laboratories

Earthworms, despite their prevalance across the state and region, aren't native to the area.

Soil horizon swings

Researchers dig into what earthworms wiggling into previously worm-less areas around Itasca and northern Minnesota means for soils.

The team loads up the bags of dried mustard in the car. Next stop: northwest Minnesota. It may sound like a restaurant delivery, but the condiment's final stop won't be a diner booth.

Kyungsoo Yoo, a professor in the University of Minnesota's Department of Soil, Water, and Climate, predicts that the lab goes through more dried mustard than any restaurant establishment in the Twin Cities. In fact, dried mustard is a critical part of their research operations.

An ongoing research project in the Yoo lab —with roots just miles away from Itasca Biological Station and Laboratories (IBSL)— focuses on subterranean species with an aversion to mustard. "If you pour a mustard solution on the ground, earthworms will wiggle up from below," says Sara DeLaurentis, a graduate student in the Yoo lab.

Despite their prevalence on the Minnesota landscape, earthworms aren't native. When glaciers receded from Minnesota around 10,000 years ago, plants and soil fauna returned, sans earthworms. Without earthworms, leaf litter slowly accumulates and piles up in a mulch layer at least several centimeters thick. This mulch layer insulates the soil below from temperature swings at the surface. "We're interested in how the arrival of earthworms impacts the temperature at the soil surface and at different soil depths," says DeLaurentis.

Earthworms bring about big changes to forest soils. They burrow, consume organic matter and poop. By doing so, they churn up the soil contents and accelerate decomposition. The majority of research up to this point focused on deciduous forests, comprised of broadleaf oaks, maples and other trees that drop nutrient-rich leaves every fall. Evidence points to faster nutrient cycling and thinner leaf carpets in deciduous

(Continued on page 4)

DIRECTOR'S MESSAGE

Greetings from Itasca!

I hope this note from the North finds you well. In my last message, I mentioned that things looked busy for 2022 — it's still true. A bumper crop of incoming first-year students will require seven rather than six sessions of Nature of Life. Our scholarships continue to grow in donor commitments and in student applications.

Continuing the trend of growth, field course enrollments have nearly doubled in just three years. Ornithology is back on the books to make for five courses. Some students are on waiting lists to join in the fun. Things are cookin'.

I wanted to take a moment to share a few beginnings and endings at Itasca. First, although bittersweet, Dr. Lesley Knoll will be leaving us in July for a tenure-track faculty job at the University of Miami in Ohio. She is heading back to her academic roots but with a new spin as Assistant Professor. We wish her the best – she will be missed.

We also have new hires since January. Heather Kokesh has joined as Operation Associate, splitting time between St. Paul and Itasca. Jacob Sauer is our new Maintenance Carpenter, living just up the road from the Station. Heather and Jake not only create amazing opportunities as hires, they are wonderful people who understand the potential of Itasca. So glad to welcome both!

Jonathan Schilling
Director, Itasca Biological Station and Laboratories

Seasons come, seasons snow

Winter season buzzes ... and scrapes, groans and hums.

The lively summer season is what most know of the Itasca Biological Station and Laboratories, but the beautiful, busy dance of summer flies by, subsiding into a slower autumnal rhythm of packing up, loading up and putting away. As the leaves settle to the ground, cabins and labs transition into hibernation mode. Water is turned off and buildings are shuttered for the coming months of subzero temperatures and snow. In winter few buildings remain open, the station quiet as the falling snow.

Only three full-time employees remain behind on site. Amid the building projects, research and planning for next summer, we resume the annual battle to keep University Circle free of snow. This current winter season has put our snowplows, snow blowers and backs to the test (thank you, Eric and Jake!). We had 66.5 inches of snowfall from November through February, almost triple thae amount in the previous year.

Through a cold April, we are eager for ice out, the arrival of spring and the flurry of activity to reawaken the station. The sleeping buildings are cleand and shined, ready for visitors. Dawn and the kitchen staff will soon return to whip the dining hall back into shape, and whip up our favorite delicious dishes. We are looking forward to an action-packed summer, teaming with students, professors, instructors and staff. Hope to see you soon!

—Lindsey Blake

(Top) Long shadows are a pervasive scene in the winter months. Photo: Lindsey Blake
(Right) Throughout the winter, lab groups head up to the station for writing or lab retreats. Plant and Microbial Biology Professor Nathan Springer's lab group checks out the headwaters. Photo: Nathan Springer

(L) The Big River cohort group taps maple trees at Nordrum sugar camp in Leech Lake. (R) Andreas Nordrum mentors Big River cohort members Takeo Kuwabara and Boris Oicherman from the Weisman Art Musuem. Photos: Emily Schilling

Community cohort

The Big River Continuum program sets the stage for continued engagement.

The Big River Continuum program at IBSL, which formally kicked off in 2019, is a collaboration I initiated with my "start-up" programmatic funding to link Tulane University's Studio in the Woods and the Weisman Art Museum. The Studio was becoming a field station with research, to complement decades of artist residence experiences. Itasca was becoming interested in art-science programming. One was at a headwaters — the other at the delta. The match was snug.

The program connected New Orleans–based artist Monique Verdin, member of Houma Nation, and Karen Goulet, an artist from northern Minnesota and member of White Earth Band of Ojibwe. Over the past couple of years, the two have shared meals, stories and an artistic exchange with the Mississippi River as a link.

I've grown accustomed to the meandering nature of the program and the community built around it. Like the river over its history, we took detours. Adapting to change is a key to resilience.

In 1980, a classic ecology paper written by Robin Vannote described a model river ecology as the "River Continuum Concept" of dynamic equilibrium. The paper noted that this concept is "useful because it suggests that community structure and function adjust to changes."

The constancy of change can bring stability. The Big River Continuum program is an embodiment of this idea.

In July 2021, transitioning to an Institute for Advanced Studies Creative Collaborative grant, the Big River project initiated a cohort to build community around the ongoing art-science exchange. Using "scaffold" processes led in-person at Itasca by Weisman Art Museum's Boris Oicherman, and based on process work of Pablo Helguera, the cohort began a process of development and informing purpose.

The group has met regularly, including biweekly Zoom gatherings and an in-person "Sugarbush," tapping maples together near Cass Lake with Shirley Nordrum, an educator with the University of Minnesota in the Federally Recognized Tribes Extension Program.

As I watch the cohort spin-off projects on its own, beyond the core artist-exchange program, it is gratifying from the perspective of basic community building. Field stations like Itasca need to get out of their bubbles and make community in rural areas — we should not be outposts — we should be inroads. Shirley's words sum it up best: "I think it's important to take time to sit with babies, elders and the water, just to show you care. If words are spoken, that's good, and if laughter results, that's even better."
— *Jonathan Schilling*

Coming up

The Big River Continuum program at IBSL is a collaboration with Tulane University's Studio in the Woods and the Weisman Art Museum. The program connected two artists — Karen Goulet and Monique Verdin — who live near the headwaters and the mouth, respectively, of the Mississippi River. Come see their work at two upcoming shows.

Bemidji — Watermark Art Center-Miikanan Gallery
May 13 - August 17
Aabijijiwan (It Flows Continuously)

Minneapolis — Weisman Art Museum
June 1 - August 21
Bimiwetigweyaa (The Sound the River Makes Flowing Along)

Learn more >
z.umn.edu/BRC-coming-up

"In heavily [earthworm] infested sites, the soil temperatures in mid-summer were roasting in comparison to their earthworm-free counterparts. In the winter with that insulating layer removed, that soil froze."

—Professor Kyungsoo Yoo

Sampling in the forests near Itasca State Park. Photo credit: Sara DeLaurentis

(Continued from page 1)

forests with earthworms.

Coniferous forests, characterized by their needles and acidic soils, have received less attention. Gaining a better understanding of how earthworms impact coniferous forests is important as they account for about a third of the forests in the world. With the support of an IBSL Seed-to-Root Grant, research got under way in 2019 at the intersection of deciduous and coniferous forests around Itasca State Park.

Digging in

To study the impact of earthworms, researchers first needed to find areas devoid of them. Researchers donned jackets made of bug nets to shield themselves from pesky coworkers (mosquitoes), gathered gallons of mustard solution and headed into the woods.

Despite Itasca's distance from a major urban area, European earthworms thrive there. In part, it's due to their prominence at the end of a fishing line. "We've had a hard time finding places in Minnesota that don't have earthworms. From neighborhood parks to remote portages in the Boundary Waters Canoe Area, they're everywhere," says Yoo.

Once they found sites with lower densities of earthworms in coniferous and deciduous woods, the manual work began. DeLaurentis and her team dug two dozen knee-deep pits, working around tree roots and unearthing rocks, and then buried button-sized devices that track temperature. She refilled the pits and then watched the temperature data synch. Over the next year and a half, the sensors tracked temperature every four hours.

Researchers were surprised to find that earthworms set up shop in both forest types at comparable densities. Areas with few earthworms have a thicker leaf carpet, which serves as insulation from both cold and hot temperatures.

"In heavily infested sites, the soil temperatures in mid-summer were roasting in comparison to their earthworm-free counterparts. In the winter with that insulating layer removed, that soil froze," says Yoo.

Earthworm invasions in combination with rising temperatures due to climate change mean that dramatic temperature fluctuations are on the horizon. Gaining a better sense of how that impacts soil carbon pools locally and across the globe is top of mind for many soil scientists.

Jumping off

Digging holes and logging temperature data didn't stop at Itasca. Neither have the European earthworms. Researchers recently collected the temperature sensors after more than a year underground from sites in Alaska and Sweden. Yoo, DeLaurentis and colleagues, including Lee Frelich, the director of the Center for Forest Ecology and Xue Feng, an assistant professor in the College of Science and Engineering, are in the process of analyzing data to sort out whether earthworms impact soil temperatures in the forests in Minnesota and beyond.

Recently, an invasive worm from Asia known as the jumping worm is making itself home in Minnesota. "It's quite plausible that jumping worms will replace European earthworms in Minnesota, the arctic and beyond. We want to know how that will impact soil temperatures," says Yoo.

Given the pervasive wiggle of earthworms across the globe, finding answers to these questions will be an important puzzle piece in making accurate predictions about soil carbon in the years to come.

—Claire Wilson

Sara DeLaurentis counts worms in the field.

Welcome committee gains a new member

Operations Associate Heather Kokesh will oversee hospitality at the station.

Heather joined the Itasca team this winter and is the Operations Associate. She's eager to join the tight-knit staff and call Itasca home this summer. We caught up with her to learn more about her role.

What do you do?

In this role, I wear a couple of hats. I oversee the hospitality side of the station to make sure guests have a seamless visit. This means booking cabins, communicating with visitors, and fielding questions. I'm also helping manage the logistics for field biology courses. On the finance side of things, I oversee ordering, billing, and budgeting for the station.

Why did you join the team?

This position is involved in many aspects of station life and that was a huge draw. I love dabbling in a handful of areas. No day is the same! I also love that it is a small, dedicated team with a lot of open communication.

Is there a project on the horizon that you're especially eager to take on?

One big thing is that we're trying to get rid of the half-page registration cards. We're still getting advice, but we might not have to have them at all. It will save space and time and trees not to have to manage a few thousand half-sheets of paper.

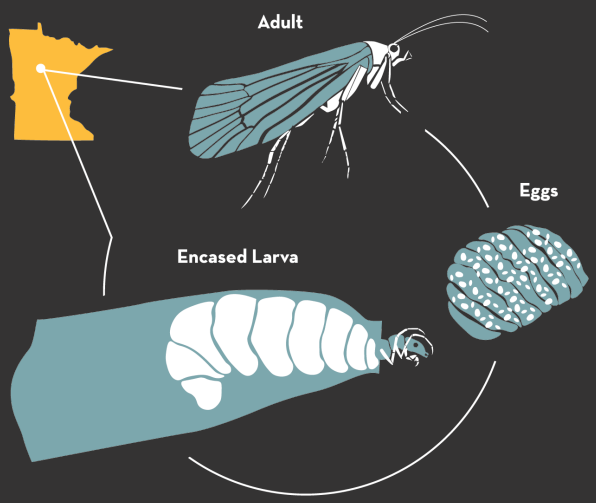
What are you most excited about spending summers at the station?

The fact that I'll be living in a state park! I'm thrilled for the opportunity to be outdoors more. Before this job, I worked in a lab for six years. Lunch breaks usually consisted of snagging a quick bite to eat in the windowless breakroom. I can't wait to take a hike over lunch instead or enjoy lake views from the picnic tables.

HISTORY

Commemorating an IBSL discovery

In 1988 and 1989, Margot Monson collected caddisflies at IBSL for her master's thesis. She described a species new to the taxonomic record. A tiny, winter-emerging caddisfly at the edge of Nicollet Creek now named *Oxyethira itascae*. Last year she worked with designers to create a new t-shirt for IBSL featuring the caddisfly.



Designed by Emma Delisi and Carlise Sorenson, members of the Science Communication Lab.

Perspective: from the field

Graduate student shares their experiences working up north.

Portaging to Elk Lake from lake Itasca.

Lakes are full of life, from large mammals down to small insects. Yet it's the smallest microorganisms that play the largest role in shaping a lake ecosystem.

Even in a single drop of lake water, there are often millions of microorganisms, such as algae or bacteria. It's difficult to study the individual impacts of these organisms, and instead we monitor common compounds — like the gases oxygen and carbon dioxide — to track their cumulative effect.

Tracking these processes holds clues to overall lake health and which gases lakes are emitting. Lakes contribute greenhouse gases to the atmosphere thanks to active microbes and need to be factored into climate change predictions.

My research studies dissolved gases in lakes and uses two new buoys on Lake Itasca and Elk Lake. The buoys — easily mistaken for abandoned boats or rafts — are adorned with solar panels and gas sensors bobbing in the waves. These buoys monitor oxygen and carbon dioxide concentrations around the clock, helping unravel the secrets of microbial activity in lakes.

Here are some highlights from the 2021 season :

May

Now that the ice has melted, the buoys are put into place in Lake Itasca and Elk Lake, northern Minnesota spring is in full swing.

June

As the weather warms, Itasca and Elk Lake have stratified – a process where the surface water warms up faster than the cooler water below. This forms two distinct layers of water that don't mix, isolating the bottom of the lake from the atmosphere. This can eventually lead to oxygen getting used up in the bottom layer, bad news for fish and other aerobic organisms!

July

Plant and algae production is highest on these hot and sunny summer days. While taking oxygen profiles on Lake Itasca, my energy seems anything but high on this balmy afternoon. Photosynthesis from algae has produced a surplus of oxygen in the surface water of the lake. In the cool dark water below, respiring bacteria have consumed oxygen and produced carbon dioxide, creating very different conditions in the top and bottom layers of the lake. A swim after taking measurements is a must. I dive down just deep enough to feel the cool water layer with my toes.

August

The hot and dry summer of 2021 continues. Wilderness drive has been closed due to fire danger, but luckily I still portage from Itasca to Elk Lake in a canoe to get monthly measurements. The

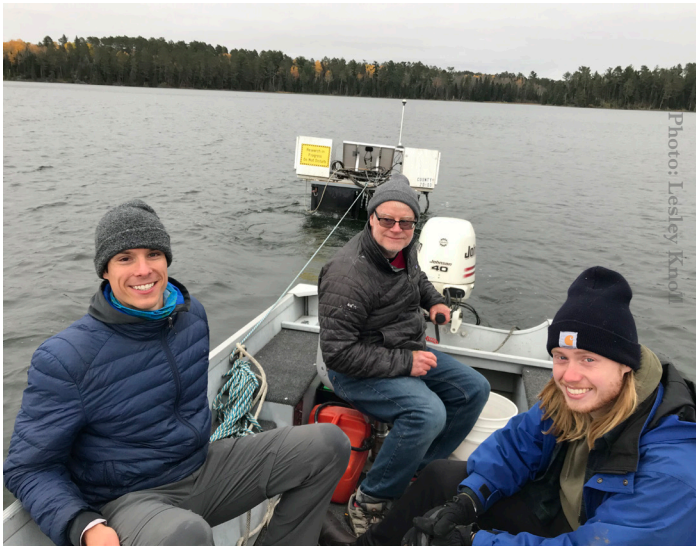
hot weather has considerably warmed the surface water on Elk to an unusually toasty 75°F, while near the bottom of this deep lake the water remains frigid, only 40°F!

September

The air is crisp, the leaves are changing, and a fall sunset over Lake Itasca bathes the sky in spectacular colors. The cool weather has caused Lake Itasca to "flip," where the top layer of water has now cooled enough to sink and mix with the water below. Carbon dioxide that had built up in the bottom layer is now released to the atmosphere, like cracking open a can of carbonated soda.

October

As winter looms, the tamaracks bordering Lake Itasca show their brilliant gold. The last measurements are taken, and the buoys are removed for the year into a storage shed at the field station. We've already placed bets on when Itasca will freeze over, but I am wondering when spring will come and the next field season can begin. — *Joe Rabaey*



Joe Rabaey, Jim Cotner and Reid Brown (from left to right) take out the Elk Lake Buoy in October.

ABOUT THE AUTHOR

Joe Rabaey is a Ph.D. candidate in the Ecology, Evolution, and Behavior program at the University of Minnesota. His research focuses on freshwater ecosystems and improving Minnesota water resource management. He received the Itasca Graduate Student Fellowship in 2021. In addition to a passion for science, he enjoys many outdoor hobbies including fishing, canoeing, running and biking.

Upstream Spring 2022

CONTRIBUTING EDITOR
Jonathan Schilling

CONTRIBUTORS Heather Kokesh, Joe Rabaey, Claire Wilson, Stephanie Xenos

Upstream is published biannually by Itasca Biological Station and Laboratories at the University of Minnesota. The University of Minnesota is an equal opportunity educator and employer. Copyright © by the University of Minnesota Board of Regents, 2022.

Itasca Biological Station and Laboratories
University of Minnesota

28131 University Circle
Lake Itasca, MN 56470

FIELD BIO BOOM

Enrollment for field biology courses hit a record high this year. The station will buzz throughout May and into June with students. Classes this year include Field Microbiology, Field Mycology, Field Ornithology, Animal Behavior and Field Mammology.