

HUBBARD BROOK RESEARCH FOUNDATION

**Annual Report
November 2021**



Our Mission:

Promoting the understanding
and stewardship of forest
ecosystems through
scientific research and
monitoring, policy outreach,
and education





THE HUBBARD BROOK COMMUNITY

For more than six decades, long-term studies of air, water, soils, plants, and animals at the 7,800-acre Hubbard Brook Experimental Forest have led to landmark discoveries including acid rain; the effects of lead, salt, and nitrogen pollution in streams and lakes; and the factors affecting migratory songbird abundance. Hubbard Brook is a network of environmental thinkers, including scientists, communicators, educators, stakeholders, and engaged citizens.



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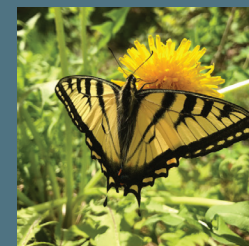
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After three-and-a-half years of terrific work as HBRF's Outreach and Communications Manager, Clara Chaisson moved on in September to pursue freelance science writing on a full-time basis. With gratitude for her many contributions to Hubbard Brook, we are cheering Clara on as she launches this new career chapter!

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HUBBARD
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On the cover:

Kai Barreras, undergraduate researcher from Wellesley College, conducting a telemetry survey of the West Bank of Lower Zig Zag Brook. The telemetry wand detects ID numbers of tagged salamanders, enabling researchers to recapture individuals and record habitat data.

Photo by Miranda Zammarelli

From Our Executive Director

“Be patient. Learn to listen. Find ways to communicate.”



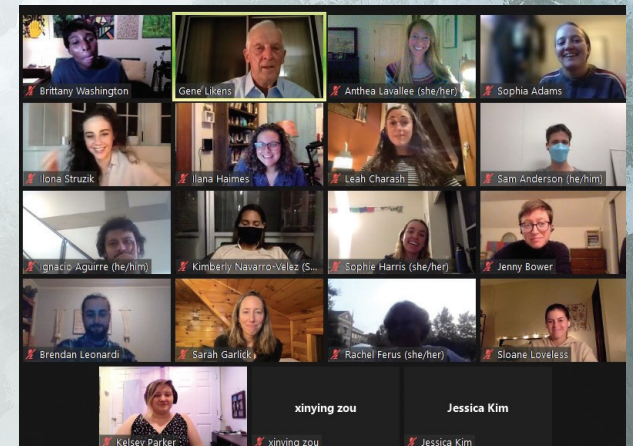
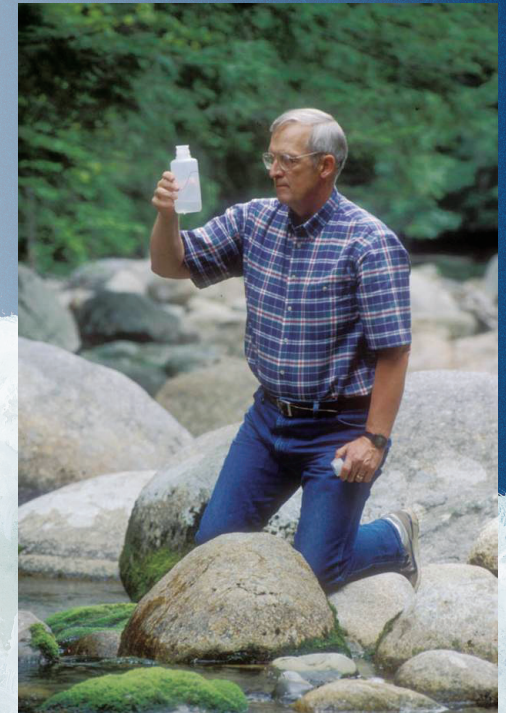
Dr. Gene E. Likens, Co-Founder of the Hubbard Brook Ecosystem Study, shared this advice during the October 14 kickoff of HBRF's fall *Young Voices of Science* (YVoS) program. Gene's legendary career spans seven decades, but he was in his 20s when he discovered acid rain, inspiring the 1990 Clean Air Act Amendments that protect our air and water. This is among the most significant science-to-policy success stories of our time, but the road to political action was long and winding. Gene described a friendly but frustrating briefing with then-U.S. President, Ronald Reagan, who commissioned 10 more years of study to confirm what Gene already knew about the polluted air that was ravaging ecosystems to the east of midwestern electric power plants and manufacturing hubs. Gene processed the first abnormally acidic rain sample at Hubbard Brook in 1963 — legal action came 27 years later, after persistent outreach to lawmakers and leaders, including three U.S. presidents and one sitting pope.

Why did crucial environmental policy take so long? What could Gene have said to Reagan to make him understand? The students' questions revealed the urgency of growing up in an existential climate crisis. Patience feels like a luxury. But there is wisdom in Gene's words. Over the past year, we've lived through miracles of modern science and medicine in the form of life-saving vaccines. We've also witnessed the alienating effects and deadly consequences of identity politics that get in the way of available solutions. Much like our fight against COVID-19, we'll need more than science to change climate policy. Integrity, tenacity, and trust were keys to Gene's outreach success. It's easy to be impatient with opposing views and to call out or “cancel” from a place of righteous anger. It's harder to be open and to listen with curiosity and respect. As Gene explained, environmental health depends on impeccable science that listens and seeks common ground.

Right now, we can accelerate solutions through audaciously good listening and fearless friend-making. In this time of hope, let's take the opportunity to build bigger, stronger networks for bold environmental action. Intergenerational conversations are an important part of the process and the basis of YVoS. Thank you for believing in this work and for your participation.

A handwritten signature in black ink, reading "Anthea Lavallee".

Anthea Lavallee (she/her)
HBRF Executive Director



Top: Gene Likens at Hubbard Brook

Bottom: Gene with YVoS participants on October 14

Background: Artwork from *Science Links* Acid Rain report, published in 2000

Dr. Charles T. Driscoll, Jr. (he/him)

Distinguished Professor of Environmental Systems at Syracuse University

Member of the National Academy of Engineering

HBRF Board Chair

Dr. Driscoll's first steps on the path to Hubbard Brook were inspired by his boyhood love of the outdoors — camping, fishing, hiking, and adventuring in the fresh air and open spaces of his native northeast. As a student, Charley was drawn to the applied nature of environmental engineering. At Cornell, he met Gene Likens and Noye Johnson while studying acid rain effects in the Adirondacks, and the rest is Hubbard Brook history. Charley went on to mastermind some of Hubbard Brook's most ambitious experiments, including the 1999 watershed-wide application of calcium, which reversed the effects of acid rain and boosted forest health and carbon capture. Charley is inspired by the problem-solving potential of science. Policy outreach projects bring him into conversation with local, state, and federal officials as well as judicial decision-makers who look to Charley as a trusted source of scientific truth. He recently provided expert testimony in a landmark hazardous waste case that may result in the single largest settlement to a non-government agency. Outreach has become a constant companion to Charley's scientific projects, and he is particularly energized about recent briefings for Congress, the White House, and industry leaders on decarbonization to combat climate change. Closer to his Hubbard Brook home, Charley is excited to see the blossoming of HBRF's youth engagement programs and looks forward to leading a strategic planning process to sharpen our vision and coordinate our efforts, for maximum impact now and in the years to come.



“For me to have outreach credibility, I need to have a firm scientific foundation, and I love science.”

Charley with Dr. Gary Lovett at the U.S. Capitol ►



Amara Ifeji (she/her)

Northeastern University Undergraduate Student

Director of Youth Engagement and Policy, Maine Environmental Education Association

2021 Winner of the National Geographic Young Explorer Award

Trustee of the Hubbard Brook Research Foundation

Amara Ifeji is blazing trails as a young environmental scientist, social justice activist, and leader. Growing up in D.C., collecting rocks and making mud pies, Amara was always inspired by the natural world. In high school, a student effort to improve local storm water management kindled her scientific curiosity and sense of purpose. A natural-born investigator, Amara was fascinated by phytoremediation techniques that deploy plants and fungi to remove toxic heavy metals from water. Today, Amara appreciates the natural world through the lens of science while channeling her passion for intersectional change through grassroots advocacy. As a leader and a woman of color underrepresented in STEM, Amara is smashing the barriers that prevent fair access to science and the outdoors, advocating for state and federal policies that promote equitable environmental literacy for all K-12 students. Building on her training and real-world experience in science and intersectional grassroots advocacy, Amara is turning her attention to policy outreach as a logical new frontier. We at Hubbard Brook are grateful for the results-oriented leadership of this dynamic change-maker.

“I strive to inspire a mindset of ecological appreciation, where the Earth is a friend.”



Mushroom photo by Joe Klemontovich ►



Brendan Leonardi (he/him)

HBRF Program and Administrative Specialist

Field Technician for the Hubbard Brook Ecosystem Study

When he isn't giving guided tours of the Experimental Forest or coordinating HBRF's K-12 education program, Brendan works to install and conduct scientific experiments at Hubbard Brook. You might glimpse Brendan on Zoom helping with meeting administration, or in the forest digging soil pits, or lugging heavy batteries used to power high-tech instruments, or shoveling snow to simulate future climate, or "eating spider webs for breakfast" when he's the first person out on the trails in the morning. Brendan's work-life at Hubbard Brook is a veritable smorgasbord, and he does it all with characteristic good humor and a rock-solid work ethic. Brendan grew up in a forested area of northern Connecticut, loving the outdoors. As a student majoring in environmental biology at Plymouth State University, he studied with Dr. Michele Pruyn in the Plant Ecophysiology Department and discovered his dual passions for trees and birds. Today, Brendan's work brings him up-close-and-personal with moose, bears, scientists, teachers, and students, and he wouldn't have it any other way. Alone in the woods or marshalling a rowdy bunch of students on a field trip, variety keeps Brendan's brain and body energized on the job. Brendan is building our capacity through the impressive quality, quantity, and variety of his contributions to the Hubbard Brook project, and the community is stronger as a result.



"I really enjoy bringing my field work experience over to the education side and getting people excited about science."

◀ Brendan talking with U.S. Senator Jeanne Shaheen before a science briefing at Hubbard Brook.
Photo by Anthea Lavallee

◀ Watching the sunset on the summit of West Bond during a summer backpacking trip.
Photo by Brendan's sister, Colleen Leonardi

Dayna De La Cruz (she/they)

Graduate, Wellesley College

B.A. in Biological Sciences, Minor in Portuguese Global Studies

Participant in HBRF's Young Voices of Science initiative, spring 2021

Dayna De La Cruz is destined for great things. Last spring, during her senior year at Wellesley College, Dayna shared her talent and passion for communication during HBRF's *Young Voices of Science* (YVoS) program. As a first-generation student, Dayna understands the need to explain her research in diverse ways to other scientists, across disciplines and, most importantly, to her family.

Growing up in Houston, Texas, television was a window into the natural world for Dayna and her family, who spent mornings watching shows on *Animal Planet*. Dayna is a native Spanish-speaker. As a child learning English, she found the content of nature-themed programs easy to understand in any language. Her scientific fluency led Dayna to pursue an undergraduate degree in biology and a variety of field studies in faraway places. Along the way, Dayna noticed how rare it was to cross paths with environmental students who looked like her. By publicly sharing her love of science as an aspiring TV, radio, and social media personality, Dayna hopes to encourage other BIPOC students to consider science as a career.

For her YVoS outreach project, Dayna created an original video about imposter syndrome in the sciences. The project ignited her broadcasting ambitions, "It was a confirmation that this is what I want to do." Dayna has big dreams and big talent to match! Her curiosity and charisma are irresistible and, as a queer, BIPOC scientist and boundary-spanner, Dayna is inspired to increase representation, making science accessible to all communities.

Stay tuned for news from this media-star-in-the-making and, in the meantime, watch her YVoS video here: <https://www.youtube.com/watch?app=desktop&v=TAAFQtSjZEI>

“Growing up, media had a lot to do with my connection with nature. I think that’s the reason I’m so passionate about science communication and media today – it’s how I got into it. Media and my family played a big role.”



◀ Flowing through a river with her peers in the Tamshiyacu Tahuayo Regional Conservation Area, Peru.
Photo by Rachel Cohen



Visiting the Chullpas de Ninamarca in the Cusco region, Peru. Photo by Soleil Osgood

Bringing Outsiders In: Raisa Kochmaruk's Stunning New Mural at Hubbard Brook Headquarters

Over the summer, visual artist and recent Cornell graduate, Raisa Kochmaruk, completed a spectacular, large-scale mural, depicting Hubbard Brook plants, animals, and streams. Raisa spent the month of July making first-hand observations of the forest. In Raisa's words, July is:

A month of illuminated American beech leaves hanging golden over deep olive shadows, and second-brood Black-throated Blue Warblers projecting their songs across new territory lines. July, for many scientists, is a story half-told, the beginning of a familiar curve, a long-awaited meeting of colleagues. It's only a brief snapshot from the kaleidoscope of life and color and sound that is the Hubbard Brook Valley.

The mural now hangs in Hubbard Brook headquarters, and we are grateful to Raisa for contributing her art and vision so generously. We also thank the small group of donors who made this project possible (see page 9).

HBRF was delighted to welcome Raisa as an official member of the team in October as our new Communications Specialist.



Mural photos by Raisa Kochmaruk



Hubbard Brook Science, Program, and Community Updates

- 🌱 Diversity, Equity, Inclusion, and Anti-Racism activities included implementing an anonymous meeting feedback survey, coordinating expert-led trainings on bystander intervention (for on-site summer researchers) and implicit bias (for HBRF Trustees), initiating the development of a code of conduct, and ongoing conversations to reckon with our past, present, and future relationships with Indigenous communities and the land.
- 🌱 During the 2020-2021 academic year, HBRF piloted an online communication training program, free for environmental undergraduate and graduate students, called *Young Voices of Science* (YVoS). Forty-two students from 20 institutions were selected to learn and practice effective methods for sharing their scientific work with non-technical audiences.
- 🌱 On February 4, National Public Radio featured Hubbard Brook's acoustic bird monitoring program and the research of Dr. Matt Ayres, Dartmouth Professor of Biological Sciences. <https://www.nhpr.org/climate-change/2021-02-04/pandemic-sparks-innovation-at-n-h-s-influential-hubbard-brook-experimental-forest>
- 🌱 On March 8, HBRF co-hosted the 2021 Climate and Clean Energy Youth Forum. This public event engaged high school, undergraduate, and graduate students with NH's entire congressional delegation, members of the Biden/Harris administration, and leaders in corporate sustainability and environmental justice. <https://www.nhyouthclimatetownhall.com/>
- 🌱 In April, HBRF contributed to a professional development series for educators, guides, and interpreters on climate justice and evidence-based climate change communication through the Northeast Climate Change Education Collaborative. <https://vteandenetwork.org/event-4178361>
- 🌱 On July 11, a paper co-authored by HBRF staff as part of the NSF Public Engagement with Science Program was published in the *International Journal of Science Education*. The paper describes the role of communication experts in creating a culture of public engagement. <https://www.tandfonline.com/doi/full/10.1080/21548455.2021.1943763>
- 🌱 In July, a film crew from the CBS Saturday morning TV show, *Mission Unstoppable*, came to Hubbard Brook to film our very own fascinating female innovator, Dr. Lindsey Rustad, HB Team Leader from the U.S. Forest Service. <https://www.youtube.com/watch?v=63jepEf4tI4>
- 🌱 On September 3, HBRF coordinated a science briefing for U.S. Congressman, Chris Pappas.

**“We cannot afford to be broken apart.
We have to be in conversation with one another.”**

**— Dr. David George Haskell, Professor of Biology and
Environmental Studies at the University of the South,
to YVoS participants during his op-ed writing workshop
on October 8, 2020**

Paying Attention to the Small Things

Every summer, Dr. Natalie Cleavitt immerses herself in the forest at Hubbard Brook, meticulously documenting the growth of individual trees in marked plots. Nat, as she prefers to be called, focuses much of her research on regeneration, the renewal of the forest by the growth of trees, beginning with seedlings. “Don’t underestimate the importance of small plants,” Nat says. “The seedlings and saplings are the future of the forest.”

Nat’s work at Hubbard Brook has revealed dramatic shifts in the forest, including stark declines in sugar maple regeneration and a rise in the dominance of American beech in the understory. Motivated by these trends, Nat wanted to hear from other forest practitioners, especially land managers and foresters, about what they are seeing in the woods and the actions people are taking to address regeneration failure.

Nat joined forces with HBRF’s Sarah Garlick, along with Cornell University students Alex Ding, Zoe Economos, Raeana Kiss, and Isabella Kong, to convene a Hubbard Brook Roundtable on the regeneration of northern hardwoods in the Northern Forest. The process began in January with 21

one-on-one interviews led by the students followed by an online dialogue event in March for 27 foresters, natural resource managers, and scientists. Together, the group discussed the challenges of managing beech competition, concerns about deer herbivory, the importance of soil science to management decisions, and what several practitioners described as the loss of their “social license” to practice forestry, as public perceptions and uses of forests in the region have shifted.

The event produced a synthesis of perspectives on forest regeneration and forged valuable new connections among forest researchers and managers. To read the synthesis and learn about next steps from the group, check out the interview synthesis and roundtable summary report available here: <https://hubbardbrook.org/regeneration-northern-hardwoods>

March 2021 Forest Regeneration Round Table ◀
Photo of Nat in the field by Sarah Thorne ▼





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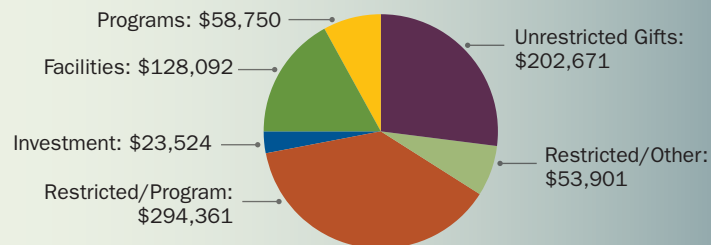
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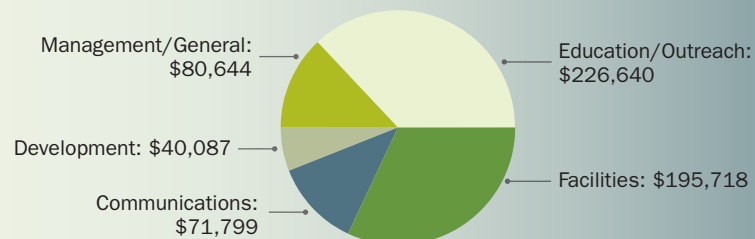
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October 1, 2020 – September 30, 2021

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Expenses: \$614,888



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Since 1988, the Hubbard Brook Ecosystem Study has received continuous funding through the National Science Foundation's Long Term Ecological Research Network. We are currently working on our 6-year renewal. The process brings us together to harmonize the science across institutions, disciplines, and priorities. It's an unusually creative time for Hubbard Brook, and we look forward to sharing our plan for this exciting next phase.

We are grateful for support through the pandemic from the U.S. Small Business Administration, Paycheck Protection Program and the State of NH, Governor's Office for Emergency Relief and Recovery.

Photos from the 2021 Summer Field Season



(above) Farrar Ransom, Stephen Kovari, and Miranda Zammarelli stopping at the top of Mt. Cushman after downloading the data from HOBO loggers.



(right) Miranda Zammarelli holding a spring salamander. Photo by Maddy Cochrane
(left) Red eft (aka juvenile eastern newt). Photo by Miranda Zammarelli