



Carol Blyberg

Disease forecasting can help flag high-risk species for on-the-ground surveillance.

IBM's Science for Social Good initiative to identify primates with the potential to carry Zika virus in the Americas. Human infection occurs when a mosquito feeds on an infected primate, then bites a person. The model identified known carriers with 82% accuracy and flagged additional primate species likely to carry Zika virus. Several of the identified high-risk species are common, abundant, and live among people. They include primates kept as pets, like white-fronted capuchins, and spider monkeys, which are hunted for their meat.

Han is applying her forecasting methods to other mosquito-borne diseases as part of the newly-formed 'Coordinating Research on Emerging Arboviral Threats Encompassing the Neotropics' project. Han says, "Using maps and models, our goal is to equip public health agencies in Central and South America with tools to predict and respond to emerging mosquito-borne diseases."

One disease system at a time, we are getting closer to being able to forecast disease, prevent outbreaks, and save lives. But, Han notes, "The strength of our predictions depends on the quality of the data that we have to feed our models. Accessing and organizing this information is a heavy lift and often, there are gaps in available field biology."

*To continue our research on forecasting infectious diseases, we need your help. We are grateful to the generous foundations and individual donors who help make this work possible.*

## EARLY WARNING FOR DISEASE OUTBREAKS

Imagine if we were able to forecast infectious disease outbreaks, and diffuse them before they harmed people. This type of early warning system is within our reach.

COVID-19 is zoonotic in origin. It originated in a wild or domesticated animal before making the leap to infecting people. It joins the growing ranks of zoonotic diseases that are a threat, among them SARS, Lyme disease, Ebola, and West Nile virus. Worldwide, 75% of new and emerging infectious diseases are zoonotic.

Science has the potential to reveal the animals that are most efficient at carrying pathogens, and the conditions that lead to spread, so that we can preempt human infection and suffering. Cary Institute disease ecologist Barbara Han is at the forefront of this research.

Han is developing models that forecast where the next disease might emerge. She explains, "Using machine learning, a form of artificial intelligence, we are working to identify which animals have the biological potential to harbor which pathogens, whether these pathogens can spread to people, and environmental signals that lead to human infection."

Some animals make riskier neighbors than others. Life history features like reproductive rate, lifespan, diet, and behavior provide clues to an animal's ability to spread disease. When this information is paired with data on environmental conditions and nearby human populations, machine learning models can prioritize risk.

In a recent study, Han looked at bats with the potential to spread Nipah virus in South and Southeast Asia, where deadly outbreaks are common. People become infected by consuming fruit or date palm sap that has been contaminated by bats. By comparing the traits of bat species known to carry Nipah virus with other bats found in the region, the model identified known Nipah-positive bat species with 83% accuracy and flagged six new bat species that are a monitoring priority.

Han has also used machine learning techniques to forecast bat carriers of Ebola and other filoviruses in Africa and Southeast Asia. The model predicted known carriers with 87% accuracy, and less than a year after publishing her results, several bat species flagged as potential disease carriers were confirmed.

In another project, Han partnered with

### HIGHLIGHTS

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# ECOfOCUS

*Ecofocus* is published by Cary Institute of Ecosystem Studies, an independent nonprofit center for environmental research. Since 1983, our scientists have been investigating the complex interactions that govern the natural world and the impacts of climate change on these systems. Our findings lead to more effective management and policy actions and increased environmental literacy. Staff are global experts in the ecology of: cities, disease, forests, and freshwater.

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## FROM OUR PRESIDENT

Dear Friends:

Eight months into a pandemic: what will the next year, or decade, bring? What gets me through these times is imagining a brighter future for science and building a stronger foundation for Cary amidst everything we face.

- We launched the *Campaign for Cary* to ensure we have 21st century facilities for 21st century science. In two months, we raised \$400,000 towards the campaign goal.
- Cary scientists are pursuing projects to predict, and prevent, the next pandemic.
- Our labs have reopened, our work continues, and our goal is zero COVID-19 transmission.
- Cary's virtual public events are engaging thousands of new audience members, extending our reach into new geographies.
- Our education program is making virtual resources available to teachers, students, and caregivers across the country at no cost to users.

This bright future is possible thanks to dedicated trustees, generous donors, and friends like you. Your investment shows that you value science.

And the scientists you support are leaders. Kathie Weathers recently assumed the Presidency of the Ecological Society of America; remarkably, in the last 35 years, four Cary scientists have held this position. Emma Rosi was appointed to the EPA's Science Advisory Board, where she can help ensure that the best science informs the agency. Rick Ostfeld and Felicia Keesing are concluding *The Tick Project*, and will soon have the best available guidance on tick-borne disease prevention.

This December, we hope you can join us for our virtual *Topping Out Ceremony*, when the highest beam will be placed in our renovated headquarters. Visit the *Campaign for Cary* page for more information ([caryinstitute.org/campaign-for-cary](http://caryinstitute.org/campaign-for-cary)).

Stay healthy and keep in touch.



John Halpern



Joshua R. Ginsberg, PhD

### CAMPAIGN FOR CARY

This summer, we launched the **Campaign for Cary** to generate critical support for our reimagined headquarters. These modern facilities will allow us to live our mission, convene and collaborate, work efficiently, and think deeply.

**We need your help.** Our scientists are tackling environmental issues that you care about – freshwater and forest health, prevention of emerging diseases, and the sustainability of cities. With your gift to the Campaign for Cary, you can be the catalyst for science-based solutions.

**To give:** [caryinstitute.org/campaign-cary-gift](http://caryinstitute.org/campaign-cary-gift)

Want to stay up-to-date on the latest Cary happenings?  
Subscribe to our **e-newsletter** today at [caryinstitute.org](http://caryinstitute.org).

# ASK THE SCIENTISTS

## NEW FUNDING FOR LAKE RESEARCH

An international team of researchers, community scientists, and managers is working together to understand and manage lakes around the world. The Global Lake Ecological Observatory Network (GLEON) includes over 170 lakes in 63 countries; its members are working together to reveal lakes' response to environmental change. We would like to express our deepest gratitude to an anonymous donor who gave a generous gift of \$200,000 to support this work.

Cary's Kathleen Weathers, a founding GLEON co-chair, was one of the network's first leaders. She helped guide and grow GLEON from its

infancy to a 900-member grassroots network with a focus on training the next generation of lake leaders.

Weathers says, "To protect lakes and the essential resources they provide, we need to engage a diverse network of people, lakes, and data to learn how, where, and why they are changing. This gift will allow us to expand our network of people – our most valuable resource – to monitor lakes in places like Africa, South America, and India. With new 'eyes' on lakes around the world, we will be able to hone our collective understanding of lakes' response to global changes."

### Abdou Bah, Doctoral Student

*Department of Earth and Environmental Sciences, Graduate Center of City University of New York*

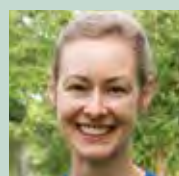


As a Co-chair of the GLEON Student Association, I help coordinate student social functions, workshops, and networking opportunities. Recently, I helped organize student workshops for a virtual 4-day GLEON meeting held in October. Workshops covered tools for lake modeling, data analysis software, and science communication.

I am from Burkina Faso, where access to drinking water is a challenge during the dry season due to water scarcity. After graduating with a degree in geology, I worked with the government agency that manages water resources in Burkina Faso to help address this issue. I then came to the US to pursue my master's in water resource management. I'm interested in how lake surface area and temperature are changing with climate change. Someday, I hope my work can help solve water shortages around the world.

### Cayelan Carey, Associate Professor of Freshwater Ecosystem Science

*Department of Biological Sciences, Virginia Tech*



My first GLEON involvement was as an undergraduate in 2006 during the deployment of a monitoring buoy on Lake Sunapee, NH. It was extremely exciting to be involved in this international grassroots effort in its early years. I now oversee sensors in multiple GLEON reservoirs in Virginia, and all of my graduate students and postdocs are GLEON scientists. GLEON is my research 'home'.

Science-wise, I lead research at multiple GLEON sites and contribute datasets to many GLEON research efforts. I appreciate the opportunity to see how our beautiful, dynamic, human-made reservoirs in Virginia extend our understanding of how freshwater ecosystems work.

I am inspired by the network's genuine commitment to supporting early career scientists, sharing data and ideas across disciplines, welcoming new members, and facilitating collaboration with colleagues around the world.

### June Fichter, Executive Director

*Lake Sunapee Protective Association, Sunapee, New Hampshire*



GLEON members from the Lake Sunapee Protective Association are data providers. Our instrumented buoy records lake measurements like temperature and dissolved oxygen around the clock. We also support research teams at other sites, and use the data we collect to educate the public, acting as a bridge between research and the broader community.

The reality of a global lake network dedicated to sharing data and collaborating is huge – with benefits for global freshwater health, for each lake station and country involved, and for the global community at large. GLEON is growing in numbers and breadth. As freshwater health becomes an increasingly critical issue, GLEON is providing insights into how we can safeguard this precious resource.

### Sarika Sharma, Doctoral Candidate

*Syracuse University, New York*



To share large datasets collected on lakes all over the world, GLEON collaborators rely on cutting-edge cyber tools. My research looks at how new processes for organizing data affect data sharing and use. I am interested in learning which data organization methods promote efficient data sharing.

The most valuable aspect of the GLEON network is that it gives young scholars the reins to lead. Graduate students can organize teams, lead working groups, and shape the direction of a research project. That is unique and unprecedented in science.

I am excited about the future research that comes out of GLEON. I am learning a lot about how our lake systems function and the human effects that are taking a toll on them. One memorable presentation described how road salt deposits affect lakes in Canada. It was eye-opening to see how lake systems can change over time due to human activity.

*To learn more about these GLEON members & their work, visit: [caryinstitute.org/Ask-GLEON](http://caryinstitute.org/Ask-GLEON)*



## SAFE ROADS, SALTY LAKES

Salt helps keep winter roads navigable, but it comes at a cost to the environment. In the US, millions of tons of road salt are applied to roads annually. Much of this salt washes off roads and flows into lakes, reservoirs, streams, and groundwater. As a result, our freshwaters are turning salty, with



Dreamstime

Millions of tons of road salt are applied every year in the US.

negative consequences for aquatic life and drinking water supplies. With Global Lake Ecological Observatory Network (GLEON) colleagues, Cary scientist Kathleen Weathers is studying lake-rich regions in the US to understand where lakes are at risk of salinization, and what environmental factors make lakes susceptible to high salt concentrations. A recent study focused on the Northeast and Midwest.

The team sought to estimate salinization risk for 49,432 lakes using data from 2,773 lakes in the region, factoring in 22 predictor variables such as lake area, watershed area, precipitation, land cover, and road density. Their models revealed that around 2,000 lakes in the

region are likely suffering high chloride levels and should be monitored. Top predictors included lake proximity to cropland and roadways, as well as development in the watershed.

Weathers explains, “To protect aquatic ecosystems and drinking water sources, managers must be aware of where salinization risk is high and take steps to use less road salt in these areas. We know that road salt enters watersheds, but due to spotty monitoring, we don’t know which lakes are most at risk of salinization. Our work is a step toward targeting areas where special precautions should be taken to reduce salt pollution.”

A variety of low- and no-salt deicing methods can help keep freshwaters fresh and winter roads safe. Learn more in this Cary report: [caryinstitute.org/road-salt-report](https://caryinstitute.org/road-salt-report)

## HYDROPOWER IN THE AMAZON

Over 150 hydroelectric dams are currently in operation or under construction in the Amazon River Basin, with hundreds more proposed. These important energy sources can have serious environmental impacts. Dams create barriers to migratory fish and alter the flow of water, nutrients, and sediments downstream. The proliferation of new dams has worrying implications for ecosystem health and biodiversity.

To plan hydropower projects with minimal environmental impact, we need to understand how river damming affects downstream ecosystems, and we need to think beyond individual projects to consider entire river systems. Two common types of dams are storage dams, which create large reservoirs and can reduce downstream flow, and run-of-river dams, which generate power without a large reservoir and create relatively little change in flow. It is generally thought that run-of-river dams are less harmful.

New research led by former Cary visiting graduate student Rafael Almeida, and co-authored by Cary’s Steve Hamilton, Emma Rosi, and others, took a closer look at run-of-river dams’ effects on downstream flow. The study focused on two of the world’s largest run-of-river hydropower dams, the Jirau and the Santo Antônio, located on the Madeira River, the largest tributary to the Amazon River. Of particular concern was the practice of hydropeaking – when water is temporarily released to increase energy production during periods of high demand.

Hamilton says, “We found that hydropeaking significantly increased downstream flow variability in short-term

increments – on the scale of hours to days. These sudden changes in flow can cause fish stranding, an effect corroborated by local reports of fishery decline. Little is known about the effects of hydropeaking in the Amazon region, but it is clear that its environmental ramifications need more consideration. To guide future dam siting and design, it is critical that we understand the full scope of potential effects.”



Rafael Almeida

Santo Antônio dam on the Madeira River in Brazil.

## 21ST CENTURY FACILITIES FOR 21ST CENTURY SCIENCE

Our headquarters renovation is underway. Over the coming months, we will be transforming our Millbrook campus to better advance ecological science. The renewed headquarters will have additional space for research and will be energy-efficient, sustainable, and healthier for people and the planet. When complete, the

building will better serve scientific research, meet LEED Platinum standards, and feature state-of-the-art health protections informed by the COVID-19 pandemic.

Cary President Joshua Ginsberg says, "Renovations will create the collaboration space needed for 21st century science, while allowing us to thrive in Millbrook for decades to come. Our reimagined headquarters will benefit our science, as well as the many students, educators, visiting scientists, local institutions, and guests who are vital to the Cary community.

It's an investment in our future, and a sign of our strong roots in Dutchess County."

Sustainability is at the heart of the renovation plans. Updates to the building will allow Cary Institute to live its mission by eliminating reliance on fossil fuels and making its operations highly energy efficient. Forest Stewardship Certified wood and wood products, and recycled materials, will be used during renovations. We are working to subcontract to local vendors, ensuring the project contributes to Dutchess County's recovery from COVID-19.

We look forward to the next chapter in Cary Institute's history.

You can view our virtual groundbreaking ceremony here: [caryinstitute.org/groundbreaking](https://www.caryinstitute.org/groundbreaking)



New designs prioritize sustainability and features that support health.

Becker + Becker

## HANDS-ON WATERSHED RESEARCH FROM HOME

The Mid-Hudson Young Environmental Scientist (MH-YES) program brings together local high school students, science teachers, undergraduates, and scientists to explore watershed ecology in the Mid-Hudson region. This year, MH-YES was run virtually, with students conducting investigations near their homes throughout Dutchess County.

Participants were divided into Cary Institute and Marist College teams. Over six weeks, the teams developed research questions, conducted field experiments, and analyzed their data.

Education Program Specialist India Futterman explains, "Student projects were ambitious: one looked at whether vegetation type impacted soil water quality following Hurricane Isaias. The other explored 'water budgets' in the students' home ecosystems. Both teams had to adapt their projects to accommodate COVID-19 constraints, but the students were undeterred. Mentors instilled lessons about problem-solving, communication, and flexibility during the research process."

*Here are some student reflections on the experience:*

"After doing the MH-YES program, I feel more confident in my ability to analyze data. Typically in class, there's only one defined way the data can be derived and interpreted – and you get dinged if you do something different. This summer, I learned there can be many correct ways to solve a problem." – Sophie Lucal, Millbrook High School

"The program increased my confidence with environmental science and working as a group because I was able to work with people who have the same kind of drive as me, that are motivated to work. I learned a lot while being told that it's okay to

make some mistakes because you learn from them." – Kaiya Lasher, Franklin D. Roosevelt High School

To learn more about the virtual MH-YES program, check out this post by Cary educators India Futterman and Ashley Alred: [caryinstitute.org/virtual-MH-YES](https://www.caryinstitute.org/virtual-MH-YES)



Left: Rachel Earnhart takes a DBH measurement. Right: Adriana Belinky collects a soil sample.

Submitted by Rachel Earnhart and Adriana Belinky



# OUR THANKS TO YOU

## JOIN THE **LITTLE BLUESTEM LUNCH COMMITTEE**

Plans for Cary's Little Bluestem Lunch are underway. If you would like to join the committee, please contact Adelaide Goldfrank (goldfranka@caryinstitute.org). In thanks, committee members will be invited to attend a private virtual cocktail party with Cary disease ecologist Barbara Han.



Justin Schmidt

We asked **Aldo Leopold Society Member David Lavarney** why he supports Cary Institute:

"When schools closed in March, Cary's trail system became a lifeline for me and my family. Our children became experts at identifying plants and spotting day-to-day changes as spring turned into summer. We are looking forward to more discoveries this fall. Joining the Aldo Leopold Society was our way of saying thanks, while giving back a little to support Cary's vital work."



Left to right: David, Naia, Heather, and Mason Lavarney

– David Lavarney

## THANK YOU TO **GRETCHEN LONG**



Pamela Freeman

As Chairman of the Board of Trustees of the then Institute of Ecosystem Studies (IES), now Cary, Gretchen attended the opening of the Cary auditorium in 1994 and was among those wielding shovels at the groundbreaking ceremony for the Gene E. Likens Laboratory in 2000. We were grateful that Gretchen could join us this fall to dig at our groundbreaking ceremony to kick off Cary's headquarters renovation.

Gretchen Long, Honorary Trustee, Founding Board Chair

## IN MEMORY OF **OAKLEIGH B. THORNE**

Cary Institute mourns the passing of Oakleigh B. Thorne. Oakleigh was a founding Trustee and member of the President's Advisory Council. He was also a member of the President's Circle of the Aldo Leopold Society and a steadfast supporter of our work. We are tremendously grateful to Oakleigh for his 36 years of leadership.

Milada Vomela

# IN CASE YOU MISSED IT

### **Preventing Pandemics: Why Biodiversity Matters**

Cary Science Conversation featuring Cary's Rick Ostfeld and Bard's Felicia Keesing  
[caryinstitute.org/PreventingPandemics](http://caryinstitute.org/PreventingPandemics)

### **Trees in Trouble**

Cary Science Conversation featuring Cary's Gary Lovett  
[caryinstitute.org/TreesinTrouble](http://caryinstitute.org/TreesinTrouble)

### **The Future of Montane Birds**

Catskill Science Collaborative Lecture featuring Jason Hill of the Vermont Center for Ecostudies  
[caryinstitute.org/MontaneBirds](http://caryinstitute.org/MontaneBirds)

### **An Ecological Approach to Wildlife Stewardship**

Three-part workshop series presented in collaboration with Dutchess Land Conservancy and The National Wild Turkey Federation.  
[caryinstitute.org/WildlifeStewardship](http://caryinstitute.org/WildlifeStewardship)

Cary's **Thursday Scientific Seminars** are now being streamed online.

Join us weekly at 11am EST to hear research updates from leading academics.

To learn more about upcoming seminars:  
[caryinstitute.org/events](http://caryinstitute.org/events)

# SUPPORT SCIENCE

## CAPTION THIS

We ran a photo contest this summer, featuring images captured on our trails and grounds. Deb Tracy-Kral and Justin Schmidt tied for the Cary Grand Prize, and Jude Murphy won the Cary Junior Prize. Deb Tracy-Kral won the People's Choice Award for her image of chatty tree swallows, pictured here.

To celebrate this charismatic image, we're asking readers to submit captions. The winning caption writer will receive a Cary Institute baseball cap.

Please send your submissions to Erin Frick ([fricke@caryinstitute.org](mailto:fricke@caryinstitute.org)) by December 1, and keep an eye on our social media, where we will post top contenders.



Deb Tracy-Kral

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Phone: \_\_\_\_\_



Justin Schmidt



## RESOURCES FOR **DISTANCE LEARNING**

Looking for ways to engage young learners this fall? Explore our free distance learning resources.

### **EcoQuest - Fantastic Feast: Who's Coming Over for Dinner? (Grades 2-7)**

Uncover the secret ecosystem where you live with Cary's EcoQuest. Complete challenges to discover the array of organisms living around us and learn what they eat. Through hands-on activities, participants will learn how to think and explore like an ecologist and earn fun badges along the way.

**[caryinstitute.org/ecoquest-home](http://caryinstitute.org/ecoquest-home)**

### **Cary Art + Science (Grades 6-12, plus adults)**

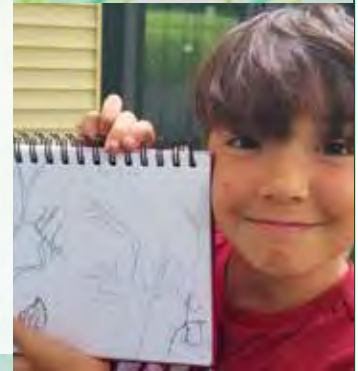
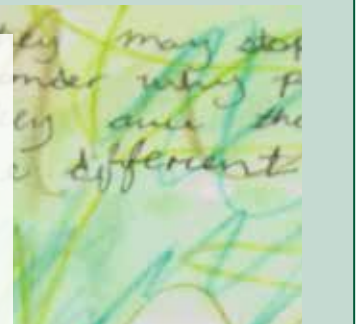
Weaving together ecology and art, these ten drawing prompts will guide participants as they explore the plants and wildlife around them. Learn how to observe nature with a closer eye and experiment with new ways of recording what you see.

**[caryinstitute.org/art-science-home](http://caryinstitute.org/art-science-home)**

### **2021 Virtual Hudson Data Jam Competition (Grades 6-12, plus families)**

Cary's Hudson Data Jam competition is a chance for students to explore scientific datasets and communicate the stories they tell through visual or performing arts. The virtual competition opens in November.

**[caryinstitute.org/eco-inquiry/udson-data-jam-competition](http://caryinstitute.org/eco-inquiry/udson-data-jam-competition)**



Kristin Martin