ECOfOCUS

CARY INSTITUTE OF ECOSYSTEM STUDIES

Science for environmental solutions — *Fall 2019*

Pamela Freeman

Aquatic ecologist Emma Rosi discusses her work with microplastics and pharmaceuticals in freshwaters at our Artificial Stream Facility.

NEW FUND FOR **CUTTING EDGE SCIENCE**

By Erin Frick

Innovation is a hallmark of Cary Institute's science. As an independent research organization, we are uniquely positioned to advance cutting-edge projects and take on research risks.

"With support from the Lang Assael family and other generous donors, we have started a new fund dedicated to early and mid-career scientists pursuing unexplored lines of research," says Cary President Joshua Ginsberg.

The Lang Assael Family Science Innovation Fund is now at $1.5 million. It supports projects that are breaking ground in their respective fields. These projects are often otherwise unfundable because they are so cutting edge.

"Today's science funding landscape makes it difficult to obtain support for research projects that are not already part of an established program," says Ginsberg.

The first project supported by the Science Innovation Fund was a collaboration of Cary scientists – including aquatic and disease ecologists – looking at the effects of pathogens on ecosystems. The team produced a paper currently in review at the journal *Ecosystems*.

Ilya Fischhoff, a postdoctoral researcher at Cary Institute and lead author on this project says, "Parasites and pathogens are tiny, but they can have major impacts on ecosystems – from vegetation and wildlife health, to water and soil quality. We wanted to bring together Cary scientists working in different areas of ecology to explore pathogen effects on biogeochemical cycling and ecosystem productivity. We need this kind of cross-cutting collaboration to answer today's fundamental ecology questions."

Now, two new projects are set to take off, thanks to the Science Innovation Fund.

Aquatic ecologist Emma Rosi is leading a project with ecosystem ecologist Steve Hamilton exploring the effects of microplastics and pharmaceuticals on aquatic life.

Rosi explains, "Due to ineffective water treatment, contaminants like pharmaceuticals and microplastics are being released into the environment. We are looking at interactions between microplastics and drugs in freshwaters to see if there are effects on aquatic organisms and water quality. This is the first-ever study on the synergistic effects of microplastics and pharmaceuticals in freshwaters." This project is also supported, in part, by the Cornell Douglas Foundation.

Barbara Han is leading the second project, with Cary scientists Ilya Fischhoff, Shannon LaDeau, Rick Ostfeld, and Tao Huang. Han works on global disease forecasting, with a focus on diseases passed from animals to humans. Working with collaborators at NASA, this project aims to prototype a global early warning system to preempt zoonotic disease outbreaks.

Han says, "Disease risk is dynamic and changes seasonally. Current disease prediction methods tell us which species pose the greatest risk to people, but not when we are most at risk. We want to develop a forecasting model that uses continually-updating data streams on animals and environmental conditions to reflect real-time risk. No current methods approach this level of specificity."

We are grateful to all donors to the Lang Assael Family Science Innovation Fund. Your support powers pioneering – and crucial – science.

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:

Fall was ushered in by global climate marches urging decisionmakers to listen to science and take action on curbing carbon emissions. Students took the lead, and challenged us all to do the right thing; after all, their future is on the line.

At Cary, understanding the impacts of climate change drives much of our research. Efforts include: tracking the movement of invasive pests and pathogens, managing urban flooding, forecasting global changes in disease risk, and investigating forestry practices that maximize carbon storage. You can discover these – and many other climate-related projects – on our new website.

Climate change is a core driver of ecosystem change; its impacts are accelerating, and challenging. Mitigating climate change is critical, and so we are thrilled to announce that we will soon be offsetting all of our electrical needs with solar energy.

Our new solar field is just one of many steps we are taking to do our part in the fight against climate change. Our next step is to renovate our headquarters – one of the first solar buildings in the country – to meet the Living Building Challenge design principles. Through this renovation, we will incorporate renewable energy whenever possible, with an eye toward further reducing or eliminating our carbon emissions and updating technology to support cutting-edge science.

If you have questions about our exciting new solar field, don't hesitate to ask. We are proud of the steps we are taking to live our mission, and hope to inspire others to do the same.


John Halpern

Joshua R. Ginsberg, PhD

Mary Flagler Cary **Legacy Society**

Join the Mary Flagler Cary Legacy Society, a growing group of donors who have added Cary Institute to their estate plans. They are helping ensure we remain as influential and forward-thinking in the future as we are today. For more information:

call (845) 677-7600 x203
or visit caryinstitute.org/support

Claire Nemes

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Subscribe to our **e-newsletter** today @ caryinstitute.org

ASK THE SCIENTISTS

DISEASE ECOLOGY **RESEARCH IN FOCUS**

We asked some of our scientists studying disease ecology to tell us about their current projects, challenges, and what drives them:

Surprise Photography

Shannon LaDeau

Shannon LaDeau, Disease Ecologist

Developing models that can predict when and where ticks and mosquitoes will be abundant – and likely to pose a risk to people – is an important and growing challenge that can directly improve public health.

My research focuses on understanding how climate change impacts mosquitoes and ticks, and what this means for human disease risk. One study is looking at the effects of urbanization and climate on mosquitoes. In another, I am studying ticks' response to changes in extreme weather events. I develop predictive models for how interactions between our decisions and environmental conditions can make tick and mosquito numbers rise – with the aim to guide vector management.

Factoring in the role of people is a challenge. In natural settings, mosquitoes respond to how much and how often it rains. Precipitation models can help us predict when and where mosquito numbers will grow. People manipulate the amount of water around us by watering plants and lawns – which can impact mosquitoes at very local scales. This data is not as readily available as climate data, making it difficult to account for in models.

Swatting mosquitoes and finding ticks on my daughter is a constant motivation for my work.

Richard Ostfeld, Disease Ecologist

Surprise Photography

Richard Ostfeld

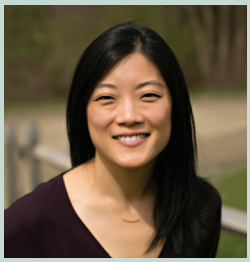
Changes in the environment caused by people – things like climate change, habitat destruction, and biodiversity loss – often increase disease risk for people, other animals, and plants. This means that environmental policy and management decisions can strongly influence our health.

Traditionally, studies of infectious disease dynamics have been dominated by biomedical specialists with little input from ecologists. This has changed in recent years, with increasing recognition that infectious diseases are ecological systems. The ecological perspective is important because most infectious diseases of humans are caused by pathogens that originate in other animals.

Instead of reacting after people fall ill, we want to predict when and where we are most at risk – and guide appropriate action. Successful prediction requires understanding which species transmit disease and how animal behavior promotes or inhibits transmission. Climate and weather also play a part. We generally ask these questions about tick-borne diseases like Lyme, but we are also pursuing diseases transmitted by mosquitoes and directly by mammals.

If we can predict disease risk, we may be able to prevent illness. A major challenge is making the scientific community, policy experts, and the public aware that environmental policy is also health policy.

Barbara Han, Disease Ecologist



Surprise Photography

Barbara Han

A central question that my team is investigating is: How well can we predict which species – including animals, insect vectors, and pathogens – pose a high risk of passing infectious disease to people? We want to know what makes these organisms special. What traits do they have that make them competent disease reservoirs? Answers to these questions will inform how we balance things like development and conservation goals, and manage for a healthy future for all.

Climate change, population growth, and development all impact disease systems, but we cannot make accurate predictions when data on hosts and pathogens is sparse. Alleviating this data deficit and maximizing scientific impact will require supporting the basic science enterprise. This means hiring researchers to collect the data needed to strengthen forecasting models and understand what drives disease risk in our rapidly changing world.

Asking these questions and acting on the answers will have wide-ranging impacts on our health, land management, and species conservation. Ultimately, we want our science to help minimize human, animal, and economic losses, and to help achieve sustainable development goals at home and abroad.

OUR CITIES

CELEBRATING 20 YEARS OF URBAN ECOLOGY IN **BALTIMORE SCIENCE**

We are excited to announce the release of *Science for the Sustainable City*. Published by Yale University Press, the book is co-edited by Cary scientists Steward Pickett and Emma Rosi, with collaborators Mary Cadenasso, Morgan Grove, Elena Irwin, and Christopher Swan. The editors have all led research programs in the Baltimore Ecosystem Study (BES), a landmark long-term research project investigating the urban ecology of Baltimore, Maryland.

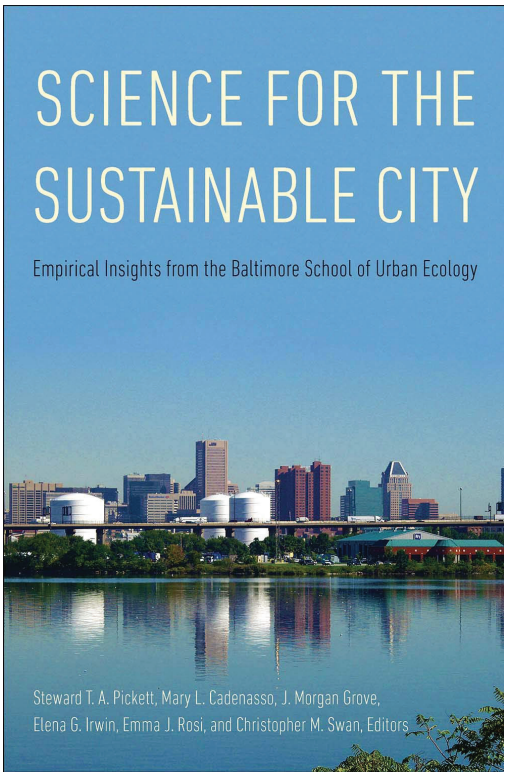
The book synthesizes 20 years of research in Baltimore and offers insights on findings, methods, and research needs that could be applied to urban research and management in cities globally.

Pickett, the founding director of BES, explains, "*Science for the Sustainable City* highlights BES contributions to policy, management, and revitalization in Baltimore. In it, we describe the history of American urban ecology, the origin and growth of BES, and the distinct environmental and social contexts that frame BES research.

It's exciting to bring these pieces together in a way that uses lessons learned in Baltimore to help guide cross-cutting research, education, and urban management in the US and abroad. Through this work, we hope to improve living conditions and sustainability not only in Baltimore, but in cities around the world."

You can join Steward Pickett, in conversation with Cary Institute Research Fellow Timon McPhearson, in their upcoming 'Cary in the City' talk at WNYC's Greene Space on February 27, 2020.

Keep an eye on our website's event page for updates: caryinstitute.org/events



OUR WATER

A LIVING LEGACY: **THE HUBBARD BROOK WATER RECORD**

You can learn a lot about an ecosystem by looking at its streams and rain water. In the case of Hubbard Brook, a research forest in the White Mountains of New Hampshire, long-term water monitoring revealed the problem of acid rain in North America. This data is part of the Hubbard Brook Watershed Ecosystem Record; established in 1963, it is one of the longest continuous records of precipitation and stream water chemistry in the world.

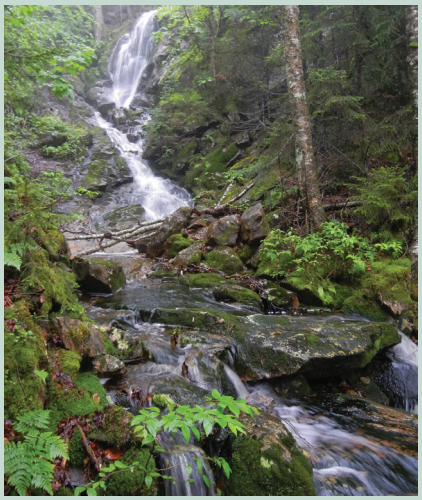
This research effort – initiated by Cary Institute's founding director Gene Likens, with collaborators Herbert Bormann, Robert Pierce, and Noye Johnson – identified rising acidity in precipitation and stream water in the early 1960s, a product of burning fossil fuels. Continued monitoring informed the Clean Air Act Amendments of 1990, and confirmed the legislation's efficacy in the years to follow.

With newly-awarded funding from the National Science Foundation, Cary Institute aquatic ecologist Emma Rosi and Duke University colleague Emily Bernhardt, are taking the reins of this important dataset into the next decade.

Rosi says, "By comparing the chemistry of rain and snow entering a forest watershed with that of water flowing out via streams, you can learn how a system is responding to things like air pollution and forest management. Today, we're using Hubbard Brook water data to study forest recovery from disturbance, including effects of a calcium silicate addition done to remediate decades of acid inputs, and long-term changes in precipitation chemistry."

Future work will document changes in Hubbard Brook's water chemistry due to warming winters, increased storm flows, reduced snowpack, and natural forest disturbance.

Cary Institute is honored to steward the Hubbard Brook Watershed Ecosystem Record dataset into the future and ensure that this record continues to inform environmental policies and forestry practices.


Claire Nemes

Streams at Hubbard Brook Experimental Forest have been monitored since 1956.

HIGH SCHOOLERS STUDY **HUDSON TRIBUTARIES**

High school students engage in hands-on research in the Mid-Hudson Young Environmental Scientists (MH-YES) program. This summer, our second cohort of MH-YES participants focused on water quality projects in Hudson River tributaries.

MH-YES gives students an opportunity to create and complete a research project and work with mentors in various STEM (science, technology, engineering, and mathematics) fields. Students also learn how to communicate their work and its importance to public audiences.

Participants were grouped into two teams, one based at Cary Institute and the other at Marist College. Each team included a scientist, a high school science teacher, an undergraduate student, and four high school students from the Poughkeepsie area.

Pamela Freeman

MH-YES participants

The MH-YES team based at Cary focused on how dams impact water quality in the Fallkill Creek. The Marist team looked at harmful algal blooms in rural and urban streams. During the immersive six week program, students chose a research question, designed a field investigation, collected and analyzed data, and presented their findings at a public symposium.

In a post-program survey, all students noted that the experience enhanced their confidence in doing science, intentions to study science in college, and awareness of career options.

One student wrote, "I wasn't sure at first, but now I feel like I can do science. We got to go into the field and learn about the Hudson River. We experienced 'real' lab work, worked with a 'real' scientist, and did things we don't get to do in school."

A teacher said that the program will have a "dramatic impact" on her teaching approach and noted that the teamwork she helped facilitate should be the standard in classrooms, rather than the exception.

We look forward to welcoming the third round of MH-YES participants in 2020. For more information: caryinstitute.org/eco-inquiry/mid-hudson-yes-program

BUILDING SUSTAINABLE **FORESTS IN CENTRAL AND SOUTH AMERICA**

Tropical forests trap carbon in their vegetation and soils, comprising 70% of the world's forest carbon sink. This crucial buffer against climate change is at risk due to logging, agriculture, development, road construction, and mining.

Cary Institute Research Fellow Sarah Batterman studies tropical forests in Panama, with a focus on ways to amplify tropical forest recovery following disturbance, and the role of nutrients in this process.

Batterman says, "Preserving intact forests is the best way to save biodiversity and protect the tropical carbon sink. But in many regions, forests are already cut. Our focus now is to boost forest recovery. We want to maximize the rate of forest regrowth and carbon storage potential."

By determining the best mix of tree species and soils to take up carbon, Batterman's team can advise government agencies, non-profit organizations, and private practitioners working on reforestation projects in South America, including the Amazon.

Nutrients can promote or limit forest growth. Understanding their role in tropical ecosystems is key to optimizing reforestation. Using a long term, whole-ecosystem experiment in Panama, Batterman is studying effects of nutrients on forests' carbon storage potential.

"We are fertilizing large swaths of rainforest to test how forests grow back and how nutrient availability influences the rate of forest recovery. We are also interested in biodiversity. We don't just want to grow trees and trap greenhouse gases; we want to create healthy forests that can support rich wildlife communities and thrive in a changing climate."

Reforestation projects are, in part, spurred by shifting demographics and economic factors.

Batterman explains, "In Panama, young people are moving to cities for work instead of raising cattle, abandoning cleared land. NGOs offer incentives for reforesting such sites – an approach that many tropical countries are embracing in order to meet climate targets committed under the Paris Climate Agreement and the Bonn Challenge."

Sarah Batterman

Abandoned pasture adjacent to natural forest in Panama. Here, Sarah Batterman is studying nutrient limitation on forest recovery. As the cleared pasture reverts back to forest, Batterman's team will study differences between the 'new' and natural forest.

OUR THANKS TO YOU

TACKLING **TICK-BORNE DISEASE**

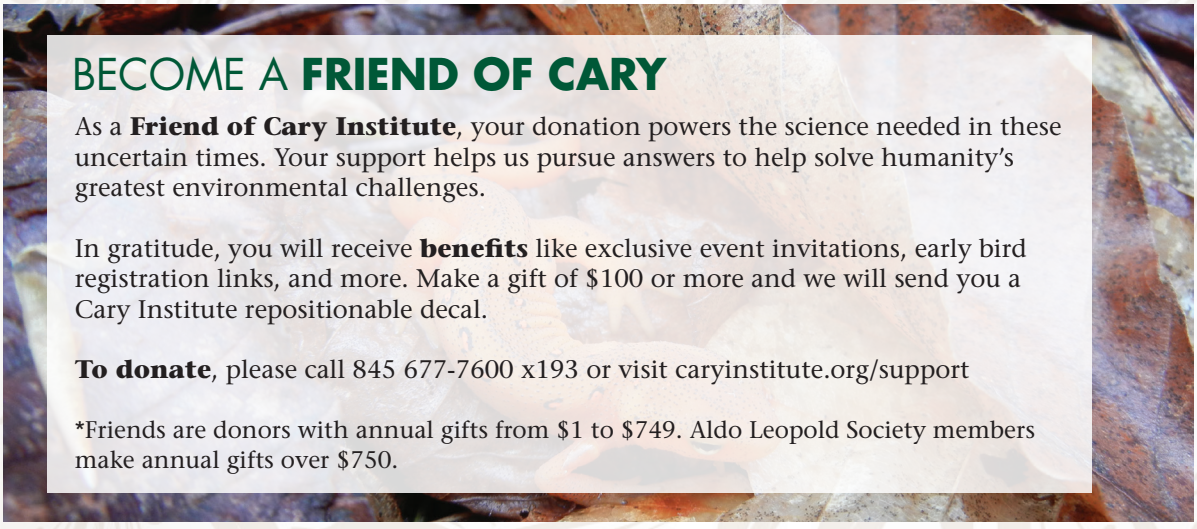
With collaborators at Bard College, Cary Institute disease ecologist Rick Ostfeld is leading *The Tick Project*, a 5-year study testing methods to reduce tick numbers at the neighborhood level. If these methods prove successful at reducing cases of tick-borne illness, we will be able to offer communities solutions they can put to work immediately.

Thank you to all who supported the '**Kick The Tick**' fundraiser in September. Your generosity made the event a huge success and helped us honor **Donna Bolner** and the Dutchess County Tick Task Force, and **Jill Auerbach**, Chair of the Hudson Valley Lyme Disease Association. Their tireless dedication to this issue is inspiring.

We are also grateful to the legislators who worked to pass crucial funding for Lyme disease research, education, and prevention in the 2019 New York State budget, among them Senators **Sue Serino** and **Jen Metzger**, and Assemblymember **Didi Barrett**.

"Tick-borne illnesses have impacted many people in the Hudson Valley region, including our family. We still don't have an answer as to how to prevent them, but our support of The Tick Project is one way we can make an impact towards finding solutions." – Karen and Nevill Smythe

Karen and Nevill Smythe



Claire Nemes

BECOME A **FRIEND OF CARY**

As a **Friend of Cary Institute**, your donation powers the science needed in these uncertain times. Your support helps us pursue answers to help solve humanity's greatest environmental challenges.

In gratitude, you will receive **benefits** like exclusive event invitations, early bird registration links, and more. Make a gift of $100 or more and we will send you a Cary Institute repositionable decal.

To donate, please call 845 677-7600 x193 or visit caryinstitute.org/support

*Friends are donors with annual gifts from $1 to $749. Aldo Leopold Society members make annual gifts over $750.

IN CASE YOU MISSED IT

This summer, students in Cary Institute's **Research Experiences for Undergraduates (REU)** program gave us a taste of their projects in a series of blog posts.

Read their posts: caryinstitute.org/news-insights/features

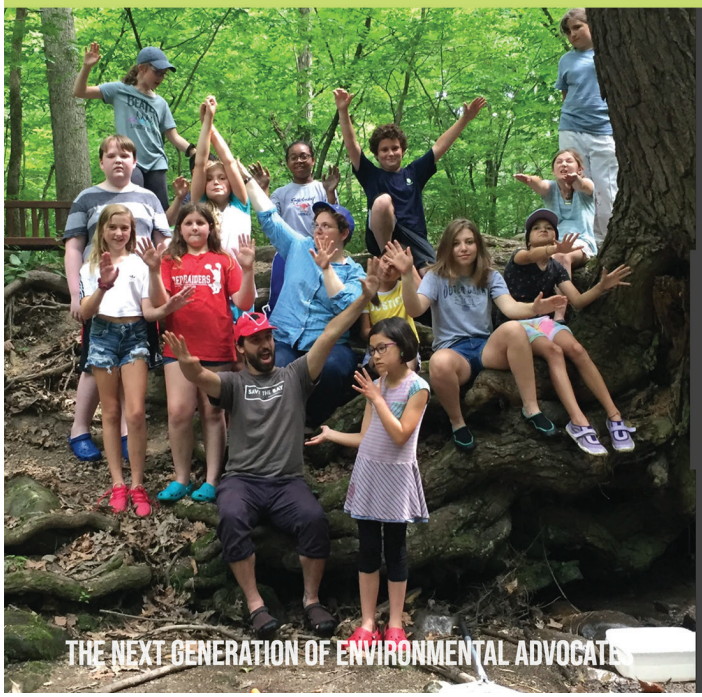
We are now **livestreaming** our **Friday Night at Cary** lectures on Facebook. If you cannot attend in person, try tuning in.

In July, **Matt Merchant**, Wildlife Biologist at the New York State Department of Environmental Conservation, spoke about **black bears and preventing human conflict** at the Friday Night at Cary lecture.

Watch this and other past talks: facebook.com/CaryInstitute/videos

SUPPORT SCIENCE

K-12 EDUCATION 2018-2019



Leslie Tumblety

BY THE NUMBERS

1277 STUDENTS LEARNED ABOUT ECOLOGY DURING FIELD TRIPS & SCHOOLYARD PROGRAMS

161 ECO-CAMPERS CAPTURED AND RELEASED **~200** CRAYFISH

LESSON PLANS WERE ACCESSED ONLINE **77,031X**

220 STUDENTS COMPETED IN THE HUDSON DATA JAM COMPETITION

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Your gift supports cutting edge science along with free ecology programs, public hiking trails, and educational opportunities for students and teachers.

❑$50 ❑$100
❑$75 ❑$250

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Aldo Leopold Society members receive newsletters, annual reports, invitations to members-only events, and reserved seating at Friday Night at Cary lectures.

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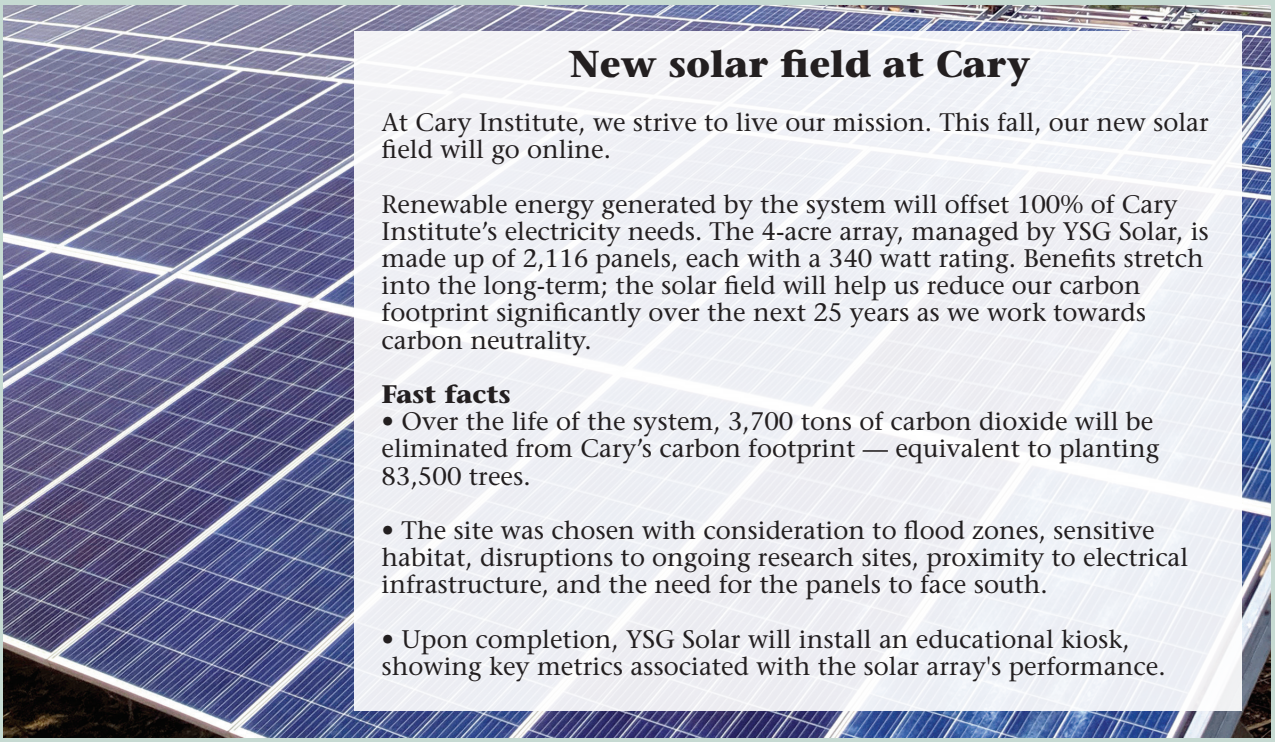
POWERING OUR SCIENCE **WITH SOLAR**



New solar field at Cary

At Cary Institute, we strive to live our mission. This fall, our new solar field will go online.

Renewable energy generated by the system will offset 100% of Cary Institute's electricity needs. The 4-acre array, managed by YSG Solar, is made up of 2,116 panels, each with a 340 watt rating. Benefits stretch into the long-term; the solar field will help us reduce our carbon footprint significantly over the next 25 years as we work towards carbon neutrality.

Fast facts

• Over the life of the system, 3,700 tons of carbon dioxide will be eliminated from Cary's carbon footprint — equivalent to planting 83,500 trees.

• The site was chosen with consideration to flood zones, sensitive habitat, disruptions to ongoing research sites, proximity to electrical infrastructure, and the need for the panels to face south.

• Upon completion, YSG Solar will install an educational kiosk, showing key metrics associated with the solar array's performance.

YSG Solar