



ECOFOCUS

CARY INSTITUTE OF ECOSYSTEM STUDIES

The science behind environmental solutions

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Steven Frame

INFORMING RESILIENT COASTAL CITIES

by Lori M. Quillen

Coastlines make up less than ten percent of the land in the continental U.S., yet they house nearly forty percent of our population. By 2020, they are expected to add another 10 million residents. At the same time, shoreline erosion and wetland loss have left coastal cities vulnerable to flooding, sea level rise, and extreme weather, while sewage overflows and polluted runoff compromise fisheries and leave waters unsanitary.

Cary Institute scientists have been exploring the ecology of coastal cities since 1997, when Dr. Steward Pickett established the Baltimore Ecosystem Study. The project is part of the National Science Foundation's Long Term Ecological Research Network. Dr. Peter Groffman, a principal investigator, has played a key role in revealing how urbanization impacts freshwater, with a focus on nitrogen pollution flowing into the Chesapeake Bay.

"How do we increase the ecological resiliency of our coastal cities – for both the health of our estuaries, and the well-being of the 123 million Americans that call them home? This is one of the overarching questions we are researching with social scientists, economists, engineers, and planners," Groffman commented.

In the 1920s, chemists discovered how to make reactive nitrogen. The nutrient, which boosts plant growth, was limited in most soils. Synthetic nitrogen has greatly increased crop production, but it has also led to nitrogen pollution. Today, we have nearly doubled the natural supply of reactive nitrogen, causing a variety of ecological problems.

Groffman explains, "In our quest to grow food and lawns, we've spread reactive nitrogen all over the environment. It's also in our waste. When reactive nitrogen enters waterways, it has damaging effects. The Chesapeake Bay receives nitrogen pollution from farm runoff, rainfall, sewage treatment plants, and decaying sewer systems in coastal cities like Baltimore."

Fish kills were discovered in the Chesapeake Bay in the 1970s. Excess nitrogen and phosphorus fueled massive algal blooms that smothered aquatic animals and reduced native eel grass beds. Modest improvements have been made, but blue crab fisheries have not recovered and the Bay remains on the Environmental Protection Agency's (EPA) 'dirty waters' list.

With partners at the EPA, the U.S. Geological Survey, the Universities of

"Lessons we are learning in Baltimore will be relevant to coastal cities broadly."

Maryland and North Carolina, and the Baltimore County Department of Environmental Protection, Groffman and Cary Institute scientists Drs. Shannon LaDeau and Emma Rosi-Marshall are investigating how environmental restoration can remediate aging sewer infrastructure. The goal: informing management solutions that protect the Chesapeake Bay and improve the quality of urban life.

A new \$500,000 grant from the National Science Foundation will allow Cary Institute scientists to quantify how urban stream restoration and green spaces mitigate nitrogen pollution. Baltimore residents and social justice organizations will be engaged in greening initiatives.

Groffman concludes, "In the U.S. alone, more than half of our estuaries are impaired due to nitrogen pollution. We are confident that the lessons we are learning in Baltimore will be relevant to coastal cities broadly."

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ECOFOCUS

Ecofocus is published by the Cary Institute of Ecosystem Studies. Our scientists are leading efforts to understand human impacts on air and water quality, climate change, invasive species, and the ecological dimensions of infectious disease. As an independent, not-for-profit organization, the Cary Institute produces unbiased research that leads to more effective management and policy decisions.

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FROM OUR PRESIDENT



Dear Friends:

In September, I arrived in Millbrook as the new president of the Cary Institute of Ecosystem Studies. During the past two months, I've met with staff to better learn what we do and where we do it. The meetings have been spectacular.

I've bounced along the Hudson River in our new research vessel, the *Ned Ames*, walked the forests of the Cary Institute, explored the Housatonic drainage, made a pilgrimage to the Hubbard Brook Experimental Forest, and visited our urban ecology research site in Baltimore. I've met with both former presidents and most of our trustees, and enjoyed events that allowed me to get to know our supporters and local citizens.

It is an honor to work closely with some of our nation's finest environmental scientists. Their work on topics like infectious disease ecology, freshwater, urbanization, and northeastern forests informs current management practices, and will shape the world we leave to future generations. I have been continually impressed with the focus, drive, and camaraderie encountered in the Cary Institute's halls. This cuts across departments, from our science and education programs, to the careful eye given to managing our 2,000-acre grounds and state-of-the-art laboratory facilities.

Our research program has deep regional roots, with long-term studies on the Hudson River's recovery, Lyme disease, and the

We are locally grown, with a national presence and an international reach.

Catskill watershed. But Cary Institute scientists also lead collaborative studies in the White Mountains of New Hampshire and in urban Baltimore, Maryland. And they are engaged globally in places like Kenya's Mara River and the coastal fog forests in Chile, and on topics like Ebola and sustainable development in China.

We are locally grown, with a national presence and an international reach. We are fortunate, as well, to have a research team committed to connecting their findings broadly, from informing resource managers to infusing ecological science into the K-12 curriculum.

As I continue learning about the Cary Institute's research, partners, and potential – my door and mind are open. I am especially interested in pursuing the diverse funding essential to enabling cutting-edge science, and extend special thanks to our Aldo Leopold Society supporters.

The future holds great things,

Dr. Joshua R. Ginsberg, Ph.D.

RESEARCH UPDATE

ROAD SALT OVERUSE HARMS ENVIRONMENT

by Lori M. Quillen

Since the 1940s, salt has been used to keep winter roads free of ice and snow. It works by lowering the freezing point of water. In the U.S. alone, some 15 million tons of salt is applied to our roadways each year. While its use has real benefits, in terms of safety and navigation, there have been cumulative costs to the environment.

In this interview, Cary Institute Environmental Monitoring Program Manager Victoria Kelly and Freshwater Ecologist Dr. Stuart Findlay provide insight into the history of road salting, its impact on groundwater, and innovations in sustainable deicing.

Where does all the salt we put on roads come from? And where does it go?

Kelly: Deicing salt is simply unrefined table salt. We mine it from underground salt deposits, which were formed by ancient oceans, using drilling and blasting. The U.S. is one of the world's leading road salt producers, with New York alone mining more than 4 million tons a year.

Enormous quantities of salt are used to keep roads ice-free. In a typical New York winter, a half a million tons of salt is applied to our state's roads. We've long known that salt corrodes vehicles and expensive infrastructure like bridges. But there is also a growing body of research that shows salt use is degrading freshwater resources.

Findlay: Road salt is not simply transported from roadways, to streams, to the ocean. Our long-term studies indicate it is retained in watersheds, where it accumulates. In some rivers and streams, peak salt levels have risen well above the federal level set to protect fish and amphibians (230 mg Cl/L). Even lower levels of exposure have negative effects on sensitive plants and animals if exposure times are long.

Kelly: We are also seeing persistent impacts in our groundwater. In Dutchess County, it's not uncommon for private



Gudella

wells to have sodium concentrations that exceed government health standards. This is especially alarming for people with sodium restrictions.

Can we use less salt and stay safe?

Kelly: Anyone who has ever been stuck behind a salt truck knows that spreaders can be inefficient. Older equipment applies salt at a steady rate, regardless of vehicle speed or road conditions. Because salt bounces, a lot ends up on the roadside, where it does little to help drivers.

Management practices can reduce salt overuse. Some are as simple as calibrating equipment, not overfilling trucks, and pre-wetting salt. There are also temperature sensors and application regulators that fine-tune the amount of salt applied. When the Town of East Fishkill retrofitted their trucks with this technology, they experienced real savings in their salt budget.

Findlay: Brine is another important deicing tool. Compared to rock salt, brine uses 60-70% less sodium chloride overall, and it doesn't bounce. Applying it before a snow event prevents the ice-pavement bond from forming, making it easier to

remove snow later on. Because brine is a liquid, it does require different spreading equipment, so there is an initial capital expense.

Are there feasible salt alternatives?

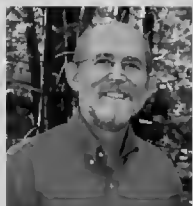
Kelly: Alternatives like calcium chloride cost about 5-6 times more than salt. Right now they are only economically feasible for vulnerable areas such as roads near reservoirs and municipal water supplies.

Findlay: From beet juice in Michigan to cheese brine in Wisconsin, novel deicers have gotten a lot of attention lately. One thing is clear – we really need to exercise best-management practices when applying salt, and invest in research on salt alternatives. It can take decades for road salt to flush out of a watershed, so the increased salt concentrations we see today will be with us even after its use has stopped.

Kelly: Together, homeowners, municipal managers, and private contractors can make a difference. For tips on minimizing salt impacts, I encourage people to look at our report *Road Salt: Moving Toward the Solution*, available on the Cary Institute's website.

SPOTLIGHTS

STAFF NOTES AND DISTINCTIONS



Charles Canham was presented with an Honorary Doctorate by the University of Quebec.



Peter Groffman was elected a Fellow of the Soil Science Society of America.



Shannon LaDeau was promoted to Associate Scientist.



Hilary Dugan has joined Scientist Kathleen Weathers as Postdoctoral Associate. Hilary is working in Wisconsin.



Christopher Dutton has joined Scientist Emma Rosi-Marshall as Associate Research Specialist. Chris is working in Africa.



Paige Barlow Ferguson has joined Scientist Shannon LaDeau as Postdoctoral Associate. Paige is working in Alabama.

The Cary Institute of Ecosystem Studies is an Equal Opportunity/Affirmative Action Employer; minorities/females/vets/disabled are encouraged to apply.

Please visit our website at www.caryinstitute.com/who-we-are/jobs for employment opportunities.



In Memoriam

Allan (Al) Kling, a member of the Cary Institute's staff since 1976, passed away on November 9, 2014. As Gardener and Head Groundskeeper, Al played a key role in the maintenance of our beautiful landscape—from the early Arboretum days to the winding trails and meadows we enjoy today. Al will be deeply missed by all his friends at Cary.



CLARIFYING THE CLEAN WATER ACT

By the late 1960s, America's fresh waters were in crisis. Rivers were catching fire, unsafe E.coli levels were common, and *Time Magazine* declared Lake Erie dead. Against this backdrop, the Clean Water Act of 1972 was enacted. It has led to improvements in pollution regulation and sewage treatment.

Still, by the EPA's estimation some 60 percent of our nation's streams and wetlands lack adequate protection and a third of our drinking water sources are at risk. Some of this stems from language in the Clean Water Act. It aspires to protect the "waters of the United States," yet it never defines what this phrase means.

Congress clearly intended to clean up navigable waters and their tributaries. But do protections extend to

floodplains? Marshes? Drainage ditches? These 'gray' cases have resulted in a slow and expensive regulatory process. To clear up ambiguity, the EPA is currently defining the phrase "waters of the United States."

Cary Institute scientist Dr. Dave Strayer comments: "The EPA's proposed definition looks sensible and supported by science. It clarifies rather than expands the Clean Water Act's jurisdiction. While there has been push-back by agriculture, it's important to remember that as much as we like farms, no industry in the U.S. uses more water, or causes more widespread water pollution."

Learn more in an essay by Strayer: www.caryinstitute.org/newsroom/cleaning-clean-water-act.

POSTDOCS IN ACTION

The trees that make up a forest influence its ability to retain carbon and nitrogen, nutrients of concern to ecologists because they impact forest productivity and water quality. Cary Institute Postdoctoral Associate Dr. Colin Fuss is investigating nutrient dynamics at the Hubbard Brook Experimental Forest in New Hampshire using greenhouse-reared saplings.

Fuss explains, "By labeling sugar maple saplings with isotopes that are rare in nature, we can trace how the carbon and nitrogen in their fallen leaves moves through the forest's soils. This provides a window into the amount of carbon and nitrogen

stored in soils and the potential for controlling nutrient pollution in nearby lakes and streams."

While nitrogen-15 can be applied like fertilizer to potted saplings, carbon-13 is an expensive gas best-suited to greenhouse application. In an enclosed setting, it is absorbed by leaves during photosynthesis.



Gary Lovett

Sugar maple leaves grown in Millbrook were transported to experimental plots in New Hampshire this fall. To learn more about nutrient studies at Hubbard Brook visit: www.hubbardbrook.org.

WHERE WE WORK

URBAN ECOLOGY IN CHINA

by Dr. Steward T.A. Pickett, Cary Institute Distinguished Senior Scientist and Director of the Baltimore Ecosystem Study

This past summer, I had the pleasure of being a Visiting International Professor at the Research Center for Eco-Environmental Sciences in Beijing. The center is part of the Chinese Academy of Sciences, and home to the State Key Laboratory of Urban and Regional Ecology. Researchers in China are well-poised to share their knowledge about urbanization; my three month stay helped put our work in Baltimore in a larger perspective.

The pace of urbanization in China is astonishing. It leads the world in the sheer number of citizens converting from rural to urban lives. For thousands of years the country was largely agricultural. Starting in the late 1970s, with the establishment of new policies, its population transformed from rural to mainly city-dwelling. Many cities were created from scratch across broad regions. And while China has a strong central government, this has not translated into straightforward urban policy or planning.

Take China's 'hokou' policy, which requires the registering of urban households. Not only do unregistered rural migrants wind up crowded into less-than-desirable rental units, but their children are not permitted to attend public schools. During my stay,



WeiQi Zhou

the Chinese government announced that hukou policies would differ based on city size. The intent is to spread urbanization across the spectrum of cities, but it will likely result in a pulse in migration, with potent social and ecological consequences.

Planning museums are a fixture in China's large cities. But plans on display often contradict facts on the ground. In Beijing, green space has disappeared under roads and buildings. Mountain districts protected in the interest of clean water also experienced tree removals for urban plantings. Tianjin held more promise. Sensitive forests, lakes, seacoast, and rivers were

buffered by boundaries. Urban residents had access to parks, and wetlands formerly devoted to agriculture were in the process of being restored.

The richness, speed, and nature of Chinese urbanization are a useful intellectual foil to the specific history and trajectory of urban change in Baltimore. I learned a great deal from my Chinese colleagues and look forward to continued collaboration on how social and ecological dynamics can inform sustainable cities. For more about my stay, visit: besdirector.blogspot.com.



Jen Rubbo

INSPIRING DATA LITERACY

by Jen Rubbo

While our trails and grounds are closed for the season, our education staff is gearing up for a busy spring. Field trips and enrichment activities are being scheduled with a focus on data literacy through long-term monitoring.

The Young Environmental Scientist Network (YES-Net) is entering its third year. Participating students in grades 6-8 collect data in Wappinger Creek. Their shared observations are used in the classroom to answer questions about stream insects. By tracking insect lifecycle events, insight is gained into connections between the aquatic and terrestrial ecosystems.

We are also planning the 2nd Hudson Data Jam, a challenge that combines river science and data interpretation with creative communication about the Hudson River. Nearly 90 students in grades 6-12 participated in the inaugural competition, with entries including songs, movies, interpretive dance, puppet shows, and dioramas.

For more information about YES-Net or the Hudson Data Jam, contact caryeducation@caryinstitute.org or visit our website.

SUPPORTERS' CORNER



Dr. Joshua Ginsberg's arrival on September 2nd as president ushered in a whirlwind of activity. Trustee Barclay Collins and Kristina Durr hosted a welcome reception for Joshua, who enjoyed meeting his new neighbors and sharing his unbridled enthusiasm for leading the Cary Institute into its fourth decade.

The Cary Institute's 4th *Fall Luncheon on the Grounds*, co-chaired by Barclay Collins and Felicitas Thorne, was a resounding success. Guests paused to read fascinating facts about our research along the pathway to the tent, and EcoKids donned waders and nets to find creatures in the Wappinger Creek. Dr. Barbara Han elicited a lively discussion about her work using machine learning to forecast emerging zoonotic diseases – those that jump from animals to humans – such as SARS, AIDS, and Ebola virus.

During the *Autumn Celebration*, Joshua introduced the scientists who led wetland walks, and thanked the Aldo Leopold Society for making our public outreach and education programs possible.



Vicki Doyle

Left to right: Kristina Durr and Barclay Collins, Byron Tucker and Elizabeth Hilpman, Catherine and Joshua Ginsberg



Vicki Doyle

Left to right: Harvey and Anita Shapiro



Pamela Freeman

Guests learned about Cary Institute research on their way to the *Fall Luncheon on the Grounds*



Pamela Freeman

Educator Lia Harris led the EcoKids stream activity



Pamela Freeman

Left to right: Helen Blodgett, Everett Cook, Torrie and Doug Larson



Pamela Freeman

Left to right: Jennifer Donnelly Dundas, Caroline Benveniste, Jacques Ya Deau, Amelie Ya Deau



Pamela Freeman

Left to right: Barclay Collins, Felicitas Thorne, Joshua Ginsberg

CALENDAR

Upcoming Public Programs

Our Public Programs are a great way to expand your ecological understanding while learning about issues facing the environment. Lectures are held in our auditorium, located at 2801 Sharon Tpk., (Rte. 44) in Millbrook, NY. Seating is first come, first served. Registration is required for outdoor events. For more information call (845) 677-7600 x 121 or email freemanp@caryinstitute.org.

Friday, December 5 at 7:30 p.m.

Green Fire: Aldo Leopold and a Land Ethic for Our Time

Join us for an award-winning documentary about conservationist and author Aldo Leopold. Learn about Leopold's vision of caring for the land and modern projects that implemented his land ethic action. Q&A with Leopold scholar Curt Meine to follow the film.

Friday, January 9 at 7 p.m.

Northern Forest Atlas Project

Wildlife Conservation Society ecologist Jerry Jenkins has been documenting landscape change in the Northern Forest for the past 45

years. This visually-rich lecture will distill his findings, with a focus on inspiring conservation and informing environmental education.



Lisa Dellwo

Friday, February 27 at 7 p.m.

Our River on Drugs

Emma Rosi-Marshall, a freshwater ecologist at the Cary Institute, will discuss her research on how pharmaceutical drugs and personal care products are polluting our nation's rivers and streams—with consequences for sensitive aquatic life and drinking water supplies.

Friday, March 27 at 7 p.m.

For the Love of Rivers

Award-winning ecologist Kurt Fausch, of Colorado State University, has spent his career exploring threats to stream and river life. His new book and accompanying videos are both a celebration of freshwaters and a call to action.

Friday, April 24 at 7 p.m.

Feeding the World While Protecting the Environment

Rosamond Naylor, Director of the Program on Food Security and the Environment at Stanford University, will talk about the challenges of alleviating global hunger.

Scientific Seminar Series

Free and open to the public, our scientific seminars are held on Thursdays at 11 a.m., from September through May, in the Cary Institute's auditorium.

December 11: Multiple Stressors on Multiple Organisms. Dr. Jacob Kerby, University of South Dakota.

January 29: Ecology and Conservation of Bats in the Anthropocene. Dr. Winifred Frick, University of California Santa Cruz.

For a complete listing of upcoming events, programs, and videos of past public lectures visit our website at www.caryinstitute.org/events.

Ways to Support the Cary Institute

Supporters receive an *Ecofocus* subscription and e-mail notification of lectures and events.

Aldo Leopold Society Members are a special part of the Cary Institute family.

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Pamela Freeman

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Visit us online at www.caryinstitute.org

RESEARCH EXPERIENCES FOR UNDERGRADUATES



Pamela Freeman

The Cary Institute is home to the longest-running Research Experiences for Undergraduates (REU) Program in the nation. For the past 27 years, the National Science Foundation-funded program has let us provide essential training to 10-12 budding ecologists each summer.



Jen Rubbo

Under the mentorship of a Cary Institute scientist, participants spend 12 weeks crafting an ecological study, writing a research paper, and discovering what it is like to be part of a research community.

Their findings are also presented at an annual symposium.

Past projects have included songbird communication, mosquitoes and disease risk, Hudson River wetlands, and the effects of pharmaceuticals on streams. Field work is completed in Baltimore, MD, Hubbard Brook, NH, the Adirondack and Catskill Mountains of NY, and throughout the Hudson Valley region.

Applications are being accepted for the 2015 program, which will run from May 26 to August 14. For more information contact Patricia Smith at 845-677-7600 x 326 or e-mail smithp@caryinstitute.org.