



Kieran Kelleher, World Bank

Fisheries play an important but declining role in removing nitrogen from coastal waters.

dropped to twenty percent. Fish harvest is unable to keep pace with escalating nitrogen runoff. This is especially troubling given our growing global dependence on fertilizer.

A continued decline in the proportion of nitrogen withdrawn by fishery harvest will contribute to an increase in the balance of nitrogen in coastal waters. From a historical perspective, this is bad news. Throughout the world, coastal ecosystems are becoming richer in nitrogen, resulting in increased phytoplankton blooms, anoxic bottom waters, and coastal dead zones.

Sustainably managing coastal ecosystems depends on understanding human impacts to the nitrogen cycle. As such, Caraco and Maranger recommend that commercial fisheries be included in assessments of the global nitrogen budget. In some areas, declining fish harvest may be one of the strongest drivers of coastal eutrophication.

FARMS, FISH, AND NITROGEN POLLUTION

by Lori M. Quillen

How is the fish on your dinner plate tied to agricultural fertilizer? Let's use the ecosystem approach to think about the big picture. On land, nitrogen-rich fertilizer is applied to crops to stimulate production. A percentage of this nitrogen makes its way into coastal oceans via a network of streams and rivers. When fish feed in coastal waters, they accumulate nitrogen as biomass. In our quest for protein, humans move fish from the ocean to the table.

While nitrogen is essential to plant and animal life, in excess it acts as a pollutant that degrades the quality of coastal oceans. A recent *Nature Geoscience* study, coauthored by Cary Institute biogeochemist Dr. Nina Caraco, has revealed that fisheries play an important role in removing terrestrially-generated nitrogen from coastal oceans.

Accounting for this withdrawal is crucial; terrestrial-derived nitrogen can stimulate coastal phytoplankton growth, leading to eutrophication. Eutrophic waters are characterized by a suite of ecological ills—from reduced dissolved oxygen and biodiversity loss to shifts in species composition. Around the world, nitrogen-

driven eutrophication is both widespread and on the rise.

With colleague Dr. Roxane Maranger, a University of Montreal scientist and past Cary Institute post-doctoral researcher, Caraco performed an analysis of coastal nitrogen inputs (fertilizer) and removal (fish harvest) from 1960 to 2002.

While things like sewage contribute to terrestrial nitrogen pollution, fertilizer runoff is the best documented and most significant source.

The prognosis is not good. Caraco comments, "During the period assessed, both fish removal and nitrogen inputs increased, but the increase in nitrogen has been much faster. While fisheries remove some terrestrial-generated nitrogen from coastal oceans, nitrogen pollution is outpacing fish removal limits." Fish harvests, which are bound by biology, can't compete with human-generated fertilizer production.

In the 1960s, nitrogen removal in fish harvest was equivalent to sixty percent of the nitrogen fertilizer delivered to coastal ecosystems throughout the world. In only four decades, this figure has

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ECOFOCUS

Ecofocus is published by the Cary Institute of Ecosystem Studies, a not-for-profit organization dedicated to understanding the natural world. Our community of more than 120 scientists, educators, and support staff is investigating the ways that air, water, soil, plants, and animals interact. From predicting how global change will influence forests to assessing air quality, Cary Institute research is critical to environmental management.

PRESIDENT:

Dr. William H. Schlesinger

WRITER & EDITOR:

Ms. Lari M. Quillen

Address newsletter correspondence to:
Communications Office
Cary Institute of Ecosystem Studies
Box AB
Millbraok, NY 12545
E-mail: QuillenL@ecostudies.org

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FROM OUR PRESIDENT



Jim Wallace, Duke University Photography

“We must have a broad base of the voting public who knows what an ecosystem is, how it functions, and how our research will lead to better environmental management.”

To the Friends of the Cary Institute:

Much has changed at the Cary Institute since our last newsletter. A new strategic plan, name, and logo will help foster a higher level of public recognition of who we are and what we do. All this stems from my belief that we must have a broad base of the voting public who know what an ecosystem is, how it functions, and how our research will lead to better management of the environment for future generations.

Nina Caraco’s work on nitrogen movement is an excellent example of ecosystem science in action. Many of us are aware that the nitrogen in fertilizer is a pollutant in local streams. In the Hudson River, submerged aquatic vegetation growing along the shoreline plays an unexpected role in removing some of this nitrogen pollution from river water. Coastal fisheries do too, because fish accumulate large amounts of nitrogen in their tissues.

Using the ecosystem approach to understand the natural flows of nitrogen, Nina’s recent research (featured on the cover) is helping to understand how human perturbations—fertilizer use

upstream and overfishing downstream— affect nitrogen levels in coastal estuaries. This knowledge is critical to protecting viable coastal fisheries.

Understanding ecosystems is central to the science at the Cary Institute. Our field sites run the gamut, from forests and lakes to vacant city lots. Steward Pickett examines urban ecosystems. If we consider how the built environment interacts with the natural environment, urban areas can be designed in a way that optimizes ecosystem services, such as air quality and the delivery of freshwater. Rick Ostfeld looks at how tick populations are regulated by variables such as acorn production and mouse abundance. By predicting disease transmission risk, this knowledge can improve human health.

Exciting things are happening at the Cary Institute. Look to us for leadership in ecosystem science in the coming decade.

Dr. William H. Schlesinger, President

LOOKING FORWARD

TODAY'S SCIENCE, TOMORROW'S SOLUTIONS EMBRACING A NEW NAME AND A STRATEGIC PLAN

by Lori M. Quillen

Change is underway at the Cary Institute of Ecosystem Studies. For over two decades, the Cary Institute has been at the forefront of ecological research. Now, in an effort to maximize the organization's influence on environmental policy, it is embracing solution-driven science and enhanced outreach.

A name change, adopted in January, is part of the organization's new face. The addition of "Cary" pays recognition and honor to Mary Flagler Cary; her charitable trust has provided the financial backbone of the organization.

A new five-year plan is at the heart of the refocusing. Drafted by Cary Institute President Dr. William H. Schlesinger, in collaboration with the organization's scientific and administrative staff, the plan was voted into effect by the Board of Trustees this winter. A number of the plan's proposed changes had been considered for several years; it began shaping the organization immediately.

The plan's central message: the Cary Institute's strength is in its science. Dr. Schlesinger comments, "The Institute excels at tackling ecological questions that cut across disciplines. This type of big-picture thinking is essential to understanding today's most pressing environmental issues, such as forest response to climate change and the procurement of renewable energy."

Over the next five years, the Cary Institute will work to refine its research program in wetland ecosystems, while building capacity in the emerging areas of sustainable energy, forest response to climate change, and the interface between ecology and human health. New scientists are being recruited to maximize the organization's expertise. A hiring search is underway for a climate change scientist, and Dr. Shannon LaDeau, a disease ecologist, will join the staff in the fall.

An enhanced communication platform will ensure that Cary Institute research is broadly disseminated. In addition to maintaining a bi-weekly science column in the *Poughkeepsie Journal*, new outreach endeavors will include briefing policy makers, hosting workshops, and creating an online resource for educating the public about the importance of ecosystems. We will also continue to provide programs for K-12 students and undergraduates through the Ecosystem Literacy Initiative.

Cary Institute Board Vice Chairman Mr. Steven Benardete comments, "The Cary Institute is a local organization with national reach. For several decades its scientists have been influential in the field of ecology; now the organization is in a position to inform decision makers. By providing leadership in areas such as sustainable energy, the new strategic plan will help bridge the divide between sound science and resource management."

Citizens can also act as environmental stewards. With this in mind, the Cary Institute is committed to hosting monthly public ecology programs. These free weekend offerings will teach guests about the importance of ecosystems, including what they are and why they matter. Learn about upcoming opportunities in the calendar on page 7.

In an effort to increase public accessibility and education, over the next year the Institute's trail system will be updated. Plans include the creation of interpretive signs and trail guides that highlight ecological themes and staff research projects.

Strengthening the organization's focal areas—freshwater health, climate change, renewable energy, and disease ecology—



Alison Dibble

The Cary Institute's strength is in its science.

will require streamlining resources. The most visible on-site changes will be the closure of the Gifford Perennial Garden and the greenhouse. These horticulture programs were initiated when the site was managed by the New York Botanical Garden.

When the grounds open on April 1st, new dawn to dusk visitor hours will make it easier to plan an excursion. Guests are encouraged to explore the Cary Institute's trails, internal roadways, and Fern Glen.

SPOTLIGHTS

NEW ECOLOGIST
TO JOIN SCIENTIFIC
STAFF THIS FALL



The Cary Institute is pleased to announce the hiring of Dr. Shannon LaDeau; she will be joining the scientific staff as an Assistant Scientist in the fall of 2008. Her expertise will complement and strengthen the Institute's programs in disease ecology and global change.

Dr. LaDeau received her Ph.D. in ecology at Duke University in 2005, where she investigated forest response to rising atmospheric carbon dioxide. She currently holds a postdoctoral fellowship in Bioinformatics from the National Science Foundation. Her position is a collaborative effort between Ohio State University's Program in Spatial Statistics and Environmental Sciences and the Smithsonian Migratory Bird Center.

Dr. LaDeau's research investigates how ecological communities respond to global change, including emergent pathogens, habitat loss, and changing climate. Her current work examines the ecological impacts of West Nile virus and evaluates the causes of differential virulence among ecological communities.

EDUCATION PROGRAM WINS GREEN AWARD

The Cary Institute was recently presented with a Green Achievement Award by Dutchess County Executive William R. Steinhaus. The honor, shared with the Millbrook Central School District, recognizes the Institute's collaborative role in developing an ecosystem literacy-based curriculum for K-12 students.

Last summer, Cary Institute educators Dr. Alan R. Berkowitz, Ms. Kim Notin, and Ms. Cornelia Tutschka helped participating teachers develop a K-5 learning progression that centered on water. Units draw on the Institute's environmental research. Individual lessons explore how water flows through different ecosystems (forests, cities, schoolyards, and ponds); the relationship between water and living things; states of water (solid, liquid, and gas); human use of water; and the nature of evaporation, precipitation, and transpiration.

Over the next year, curriculum will be developed for middle and high school instruction. The goal is to have students graduate with an understanding of ecosystems, including the impact that humans have on them. This will help empower students to make informed decisions about environmental issues.

INFECTIOUS DISEASE ECOLOGY
CONFERENCE PROCEEDINGS

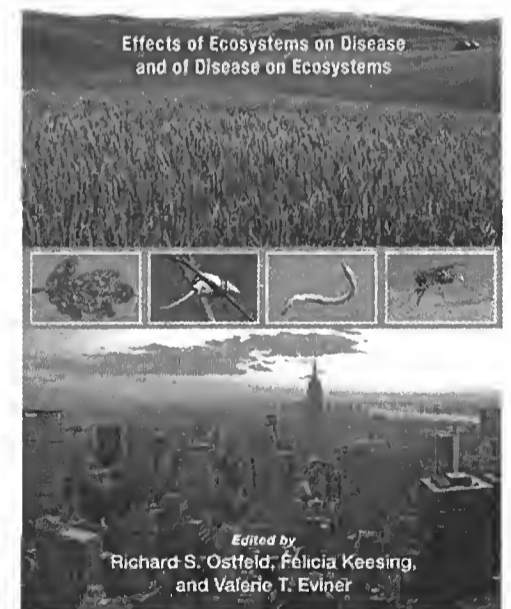
From West Nile Virus and Ebola to Sudden Oak Death, emerging infectious diseases threaten human health, wildlife, livestock, agriculture, and forests. Once established, infectious diseases cause economic and ecological burdens that can, in some cases, be irreversible.

Understanding and preventing infectious disease depends on increased dialogue among the ecologists, medical doctors, veterinarians, and epidemiologists on the frontlines. In 2005, over 80 distinguished scientists from around the world convened at the Cary Institute to participate in a conference on infectious disease ecology. Proceedings are now available from Princeton University Press.

Participant and contributor Dr. Karl Johnson, a virologist and co-discoverer of Ebola and Hanta virus, commented, "Our planet is supporting a population of 6.5 billion, with a projected 9.1 billion in 2050. As borders and ecological boundaries shrink, successfully addressing the infectious diseases of the future will require building a bridge between both sides of the disease equation— epidemiology and ecology."

With a focus on management and applications, and contributions by forty leading experts, *Infectious Disease Ecology* is helping to build that bridge.

Infectious Disease Ecology



"This book introduces the latest thinking in an exciting new field in biology: disease ecology. The authors assembled represent the most diverse collection of experts ever appearing together in one book on the subject. Both graduate students and readers from outside the field will find it exceptionally useful. It will be the source."

—Peter Kareiva, *Nature Conservancy*

WHERE WE WORK

NOTES FROM THE FIELD

DR. STEWARD T.A. PICKETT, ECOSYSTEM ECOLOGIST

LESSONS FROM THE CITY

For more than a decade, metropolitan Baltimore, Maryland has been one of my primary research sites. As the Director of the Baltimore Ecosystem Study (BES), a Long Term Ecological Research project, I work with colleagues to reveal how watersheds can be used to understand interactions among social, biophysical, and built environments.

By integrating biological, physical, and social sciences, the project brings a diversity of stakeholders to the table as it investigates an urban region as an ecological system. Partners include natural scientists, sociologists, educators, landscape architects, and urban planners.

Three major questions are central to the project: what are the fluxes of energy and matter in the city, and how do they change over time; how does the spatial structure of natural, built, and

sociological factors influence ecosystem function; and how can urban residents improve the quality of their environment and their lives by understanding the ecology of the urban system?

Unlike the natural settings that typify most ecological research, our field site is a matrix of sidewalks, structures, cultural centers, waterways, vacant lots, vibrant streets, and urban dwellers. Within this landscape, flashes of native diversity still exist, from birds to plants.

The lessons we have learned are rich. From the way that the built landscape influences water quality to the socio-economics of environmental access, an integrated approach is essential to understanding urban ecosystems. As this knowledge base grows, it can help improve current conditions and inform future urban planning.



By investigating the urban environment, the Baltimore Ecosystem Study seeks to improve the relationship between metropolitan areas and the natural world.

IS BIOFUEL SUSTAINABLE?

by Lori M. Quillen

Simply defined, sustainability is ensuring that future generations have access to the resources that we enjoy today. It was the topic of a recent workshop at the Cary Institute, where over forty ecologists discussed the sustainability of biofuel, an emerging source of alternative energy.

Most of us are aware of the negative impact that fossil fuel combustion has on the environment. Once controversial, climate change is now broadly accepted. Moving into the future, we must reconcile our need for energy with our need for a healthy planet.

A lot of hope has been pinned to biofuels. They hold the promise of being a renewable energy resource that is kinder to the environment. But are biofuels really sustainable or carbon-neutral? And which

models are most likely to be effective over the long-haul? These were among the questions before workshop participants.

The biomass needed to make biofuel can come from an array of sources, from agricultural crops such as soy and corn to managed natural areas and landfill waste. Even algal blooms have been given consideration. To date, corn-based ethanol has received the most attention from industry and the media.

Workshop participants identified several critical flaws common to most agriculture-based biofuel models. Intensive farming, and subsequent fertilizer use, would degrade terrestrial habitat, freshwater ecosystems, and coastal oceans. Current biomass-to-fuel conversion technology is both inefficient and energy intensive. And, perhaps most insurmountable, there is not enough arable land to grow the sea of plant material that would be needed to replace fossil fuel with liquid biofuel.

Participant Dr. John Harte, a UC Berkeley professor with expertise in energy and

global change, commented, "Starch-based ethanol does not make sense energetically or environmentally. There is too much degradation for too little energetic return. Biodiversity loss and pesticide pollution would be externalities passed along to future generations."

Workshop organizer Dr. Charles Canham, a forest ecologist at the Cary Institute, noted, "We need to be cautious about converting forests and natural areas into biofuel crops. Recent research has shown that this conversion releases 10 to more than 400 times as much CO₂ as the potential annual savings from biofuels produced on those lands."

For the time being, the most obvious energy solution is still energy conservation. Proceedings from the workshop will help provide research recommendations to the National Science Foundation. They will also be communicated to decision makers who need to understand the limitations of current biofuel models. A brochure is forthcoming.

DEVELOPMENTS

DEVELOPMENT OFFICE CORNER

Dear Friends,

Spring, with all its excitement and promise, has enveloped the Cary Institute. With endorsement from our Board of Trustees, Dr. Bill Schlesinger has set our dynamic new strategic plan in motion. The future is now. We are positioned for growth and increased awareness of the Institute's ecological expertise.

The Development Office maintains its important role in securing individual and family donations, staging fund-raising events, and hosting outreach programs of intergenerational interest. Well-attended lectures and receptions underscore the enthusiasm of our supporters and the growing number of educated people that recognize the importance of unbiased ecological research.

When you support the Cary Institute, you support the science behind environmental solutions. From revealing connections between the environment and disease risk to assessing the sustainability of biofuel, our researchers are on the front lines. When you invest in ecology you invest in the future.

Please join us at our events, enroll as a member, and, when possible, increase your level of membership at renewal time. I can be reached at (845) 677-7600 x120 or salsbergd@ecostudies.org.



All the best,

Diana Salsberg
Cary Institute
Development Officer



Lindblad Expeditions

SUPPORT ECOLOGY, EXPLORE COSTA RICA

Join the Cary Institute for eight days aboard a chartered vessel exploring the Panama Canal and the Costa Rican rainforest. This intimate journey, limited to sixty passengers, will take place from October 25th to November 1st, 2008.

Expert naturalists will guide participants through spectacular rain forests, coastal mountains, and tranquil offshore islands. This biologically-rich region features a diversity of plants and animals, including howler monkeys, hummingbirds, rare white ibis, parrots, toucans, and orchids.

Get close to nature. Observe the region's colorful birds while kayaking in Gulf of Panama inlets. Come nose-to-nose with tropical fish as you snorkel in Isla Coiba, one of Panama's most remote national parks. Indulge in a profusion of orchids during a stroll through Casa Orquideas,

a private Costa Rican garden. Enjoy the antics of howler, squirrel, and spider monkeys as you hike in Corcovado National Park.

Best of all, know that by participating in this memorable excursion you will be helping to support the Institute's broader mission—understanding the ecosystems that support life. This is our second chartered trip, planned in response to the success of our 2007 Galapagos Adventure.

The number of cabins is limited; act now to reserve your space. For additional information, contact Claudia Rosen at (845) 677-7600 x171 or e-mail rosenc@ecostudies.org. To view an online brochure, visit: www.ecostudies.org/IES_explores_Costa_Rica.html



Our calendar is brimming with interesting lectures and events. Of particular note is May 16th, the first of several events celebrating our 25th year. We will hold an Open House with lab tours, demonstrations, and informal talks by our scientists and staff. Looking ahead, save the date of July 27th; the Institute will be hosting a lunch event exploring the future of biofuels.

CALENDAR

Weekend Education Programs

Our family-friendly public education programs immerse participants in ecological exploration. Learn more at www.ecostudies.org/public.html.

Butterflies and Habitats

June, TBA

Learn about butterfly life while taking a leisurely hike through our open fields and meadows. The program will explore over twenty butterflies and skippers, including where they live, what they eat, and what attracts them to various habitats. Contact Kim Notin at (845) 677-7600 ext. 303 or notink@ecostudies.com.

Ecology Summer Camp

Open to children entering grades 2 to 7; sessions begin June 30 and run until August 22. Campers learn about ecology through outdoor games, hands-on experiments, hiking, and nature crafts. Each week is limited to 12 students. Register online at www.ecostudies.org/ed_eco_camps or call (845) 677-7600 ext. 333.

**Special Public Seminar
The Sustainability Challenge**

Speaker Dr. John Holdren

April 11, 4 p.m.

Discover how human activities are impacting environmental conditions and processes. Dr. Holdren is the Director of the Woods Hole Research Center and the Teresa and John Heinz Professor of Environmental Policy at Harvard University. To be held in the Cary Institute's Auditorium.

**25th Anniversary Celebration
Open House and Panel Discussion**

Featuring *New York Times* Environment Reporter Andy Revkin

May 16, tours from 4-6 p.m., reception at 6 p.m., and panel discussion at 7 p.m.

Learn about Cary Institute research through informal talks and lab tours. Then join us for a music-filled reception and panel discussion on science writing. Featured guest Andy Revkin and Institute staff will address the importance of communicating ecology on a crowding planet.

Friday Scientific Seminars

Seminars are held at 11 a.m. in the IES auditorium from September until early May. For more information, including directions, visit www.ecostudies.org/friday.html

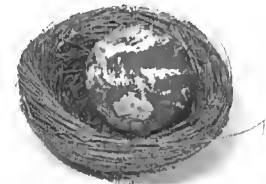
Upcoming seminars include:

April 4: Alternative pathways of nitrate removal in freshwater ecosystems, Dr. Amy Burgin, Cary Institute of Ecosystem Studies

April 18: Scientists and journalists working together: A tale of gorillas, heart disease, a swamp plant, and a biotechnology lab, Cheryl Dybas, Science Journalist

April 25: Protecting and restoring streams in an urbanizing world: back to square one, Dr. Allison Roy, U.S. Environmental Protection Agency

May 2: Cornell BEB Graduate Student Presentations, Cornell Students



Ways to Support the Cary Institute

The Institute offers two membership levels. **General members** receive an *Ecofocus* subscription and e-mail notification of lectures and events at the Cary Institute. **Aldo Leopold Society Members** are a special part of the Cary Institute family. Exclusive Aldo privileges include access to invitation-only lectures, galas, science updates, nature walks, and dinner parties.

General Membership

- \$50 Individual
 \$60 Family
 \$100 Sponsor
 \$250 Club/School

Aldo Leopold Society Membership

For those who want to invest in understanding the natural world.

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For research, development, administration, graduate opportunities, volunteer opportunities, library, and general information:

Cary Institute Plant Science Building
Box AB (2801 Sharon Turnpike)
Millbrook, NY 12545
Tel: (845) 677-5343 • Fax: (845) 677-5976

For school programs, ecology day camp,



OUR GROUNDS OPEN IN APRIL

Do you need to commune with nature after a long winter? Consider exploring the grounds of the Cary Institute. From April 1st to October 31st, we are open from dawn till dusk.

Our hiking trails are a tranquil place for bird watching and investigating a range of upland and bluebird habitats. Our four e