ECOfOCUS
CARY INSTITUTE OF ECOSYSTEM STUDIES
Science for environmental solutions *Fall 2021*

Nicholas Tonelli

Carbon storage is one of the many services provided by healthy forests.

FOREST CARBON OFFSETS: **TOO GOOD TO BE TRUE?**

In their quest to become carbon neutral, many companies purchase carbon offsets as an alternative to phasing out fossil fuels. Offsets can come from renewables, like wind and solar, or increasingly from natural climate solutions, like forested lands. Forest carbon offsets allow landowners to monetize the carbon being stored by their trees and soils and sell it on the carbon market, where there is high demand.

Over the past decade, forest carbon offsets have emerged as one of the fastest growing finance tools to incentivize forest conservation. Environmental groups, land trusts, and municipalities are involved in deals that sell forest carbon to buyers, including major corporations like Disney, JP Morgan Chase, Delta, and Google. But are these transactions leading to reductions in greenhouse gas emissions?

Cary Institute forest ecologist Charles Canham has serious reservations about the true environmental benefit of forest carbon offsets. The way credits are awarded is among his concerns. He explains, "Carbon registries are allowing gross exaggeration of the likely additional carbon storage that would be expected under an offset deal. Markets are extending credits for previously stored carbon that could be liquidated by cutting trees, yet chances of that happening are incredibly slim."

"There is no plausible path that would lead a land trust, or most forest owners for that matter, to suddenly clear-cut their forests," Canham stresses. "Yet forest carbon offsets grant corporations the right to emit as much CO2 as if the landowner had done that, in essence assuming the worst-case scenario and letting industry claim offsets based on forest carbon that had been stored over the last 50-100 years, rather than any new and truly additional forest growth."

The result: landowners with large tracts of forest are being offered significant amounts of money to enter into these agreements. "Individuals, land trusts, and municipalities are all being courted by brokers, with millions of dollars exchanging hands." And in most cases, Canham warns that credits have little to do with enhancing a forest's ability to store carbon above 'business as usual'.

Canham notes that reducing or eliminating future harvests is the most common way to bolster carbon sequestration. But this leads to a problem that economists call 'leakage'. Reducing harvest in one area often simply leads to more logging on other lands.

Adding that, "We have been offshoring our forest products for decades. New York used to have dozens of paper mills. All but a few have moved to places like Malaysia and Borneo, where they rely on plantations of short rotation eucalyptus and pine. If you do the accounting properly, this has likely increased the net flux of carbon to the atmosphere."

Canham also has environmental justice concerns. Inexpensive forest carbon credits leave little incentive to decarbonize businesses. "Polluting industries can buy forest carbon credits at around ten dollars per ton of emissions and keep spewing pollutants that disproportionately impact disadvantaged communities and communities of color."

> "Credits shouldn't be used to greenwash polluting industries when options like wind and solar present more efficient long-term carbon offset solutions."

"Our focus should be on helping landowners protect and manage the resilience of their forests so they continue to provide a range of benefits in the face of threats like forest pests and climate change. Credits shouldn't be used to greenwash polluting industries when options like wind and solar present more effective ways to reduce carbon emissions."

On November 11 at 7pm ET, Charles Canham will present a virtual Cary Science Conversation on forest carbon offsets. Join the conversation by registering at: caryinstitute.org/events.

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:

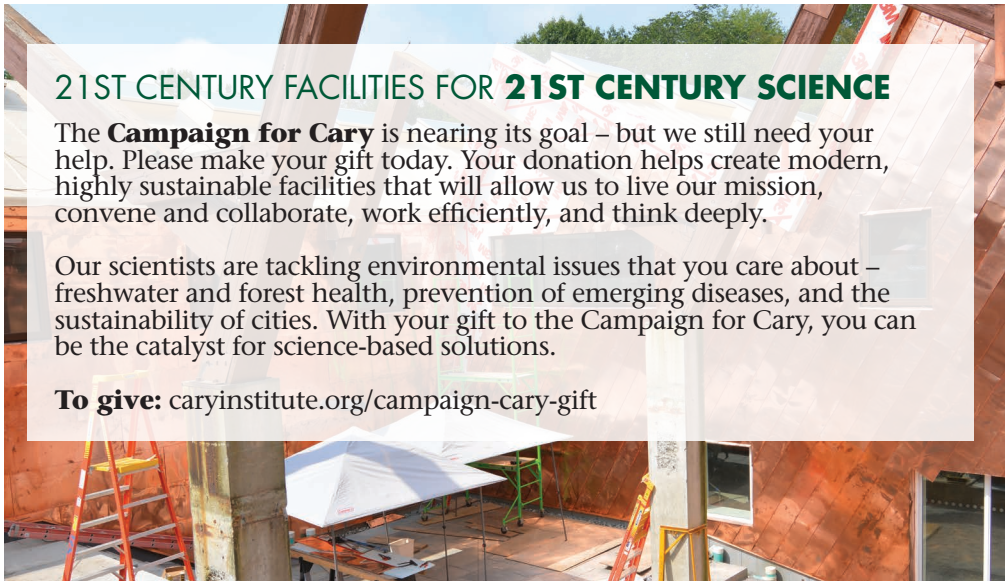
In the last 18 months, our patience has been tested in ways unimaginable. The rapid retreat, and then accelerating advance, of the Covid-19 pandemic brought hope, and dashed hopes, in the blink of an eye. But because the science on the value of masking and vaccinations is now indisputable, and because science is at the core of Cary's mission and work, I mandated vaccines for employees and all visitors to Cary Institute as of October 1.

Slowly, life will return to a new normal. Planning for that eventuality, renovations of the Ecosystem Science Building are coming to a conclusion. The building is environmentally cutting edge, with electric heat pumps offset by our solar field production, masses of natural light, remarkable insulation, 'feather friendly' glass that reduces bird strikes, and copper siding that has a 100 year life, is 90-95% recycled, and is from Revere Copper, in Rome, NY. Quiet, elegant, light filled, the building is also healthier with increased air flow, filters, no-touch features wherever possible, and windows that actually open.

We have been remarkably productive through these 18 months, as evidenced by the grants, papers, and education and outreach activities. More importantly, we have been remarkably flexible and resilient, pivoting to virtual, using new tools to support each other – whether in research groups, in networks like GLEON and Hubbard Brook, or the way in which the Cary postdocs came together to support each other, and learn from pandemic disruptions. I am proud of these achievements, and of the strength and resilience of our community.


John Halpern

Joshua R. Ginsberg, PhD



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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

David Fischer

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ASK THE SCIENTIST

WILDFIRE IN THE **WESTERN US**

Pamela Freeman

Cary forest ecologist **Winslow Hansen** is developing new ways to project future wildfire activity in western North America and determine how and why forests may respond. Here, Hansen discusses how fires in the western US are changing, what this means for people and ecosystems, and how fire modeling can guide management.

What factors influence wildfire regimes?
'Wildfire regime' describes the pattern of fire frequency, size, and severity that is typical in a landscape over long periods of time – on the scale of thousands of years. Geographic variability in factors like climate, forest types, and historic Indigenous burning practices, shape unique fire regimes across different regions.

The amount of fuel (dry leaves, branches, and dead grass) in a forest is critical. And, since some plant species burn hotter and easier than others, the type of vegetation growing in a region influences the fires that burn there.

Why are wildfires increasing?
In the western US, higher temperatures and worsening droughts create favorable conditions for wildfires to break out. More frequent, intense storms come with lightning strikes that can ignite dangerous blazes, and high winds that move fire across the landscape. Climate change is exacerbating these factors.

Fires have also been suppressed, and Indigenous burning practices stopped, for more than a century. This fire deficit has led to an abundance of brush and dead plant debris in some western landscapes. Paired with drying conditions, this is a recipe for more fire.

How are increased wildfires impacting us now?
Lives, property, and livelihoods are routinely threatened by fire. In recent years, we have seen whole towns, like Paradise, California, and Fort McMurray, Canada, completely destroyed by fire. Other effects include health consequences of inhaling smoke, which can impact communities far from the flames. Last summer, many of us in the Northeast experienced wildfire smoke from the West. In July, skies turned pink and hazy; in some places, you could smell smoke when you went outside. This smoke pollution was from wildfires burning in western Canada, thousands of miles away.

How are you projecting future fire activity?
We use computer models and information on climate, fuel density, and ignition sources – like lightning and human error (fireworks, cigarette butts, stray campfire embers) – to tell us how fire regimes and forests may change, and what factors might alter outcomes. This allows us to develop projections of how fire will affect forests in western North America through the 21st century.

How can models inform management?
We can use our models to test bold management interventions and evaluate consequences without risk. Using computer simulations, we can 'treat' large swaths of forest to see what happens if we remove all trees of a certain size, or remove fuels from the forest floor. What happens if we suppress all fires, or suppress none? Insights can help determine where and when certain interventions might be most effective.

What can we do to adapt?
Homeowners can take precautions such as building with fire-resistant materials, and removing trees and brush around their homes. On public lands abutting communities, we need to explore how proactive measures like prescribed burning, managed wildfire use (allowing naturally-ignited fires to burn), and clearing fuels from the landscape might influence fire risk for people.

Fire is going to be an inevitable component of many regions going forward. We need to learn how to coexist with fire, and how to implement site-specific adaptation strategies that can support people and changing ecosystems.

Learn more in this extended Q&A: caryinstitute.org/wildfire-qa
Watch our recent panel discussion on wildfires in the western US: caryinstitute.org/lecture-videos

Mike Lewelling, National Park Service

Alder Fire in Yellowstone National Park (2013).

EXPLORING EFFECTS OF **DRUG POLLUTION ON STREAM LIFE**

Pharmaceutical pollution occurs in freshwaters globally, but little is known about its effects on animals and ecosystems. In a study conducted at Cary's artificial stream facility, researchers investigated the effects of citalopram, a common antidepressant, on crayfish.

Cary's Emma Rosi, senior author on the study, says, "Animals living in streams and rivers are exposed to a chronic mix of pharmaceutical pollution as a result of wastewater contamination. Our study explored how antidepressant levels commonly found in streams impact crayfish, and how these changes reverberate through stream ecosystems."

Stefan via iNaturalist

Spinycheek crayfish become 'bolder' when exposed to citalopram.

Crayfish are important in streams because they eat insects, break down leaf litter, and cycle nutrients. They are stress-tolerant and can become abundant in urban waterways, which are prone to receiving pharmaceutical pollution from sewer overflows, leaky septic tanks, and even treated wastewater effluent.

To mimic natural stream habitats, the team filled 20 aerated tubs with groundwater, rocks, dried leaves, aquatic insects, and algae. Ten streams also received locally-collected crayfish. The 20 streams were split into four treatment combinations: no citalopram + no crayfish, citalopram + no crayfish, crayfish + no citalopram, and citalopram + crayfish. Over two weeks, citalopram-receiving streams were dosed with environmentally realistic concentrations of the drug.

In just two weeks, citalopram caused changes in crayfish behavior. Exposed crayfish spent more time foraging and less time hiding. Over time, these changes could disrupt stream processes like nutrient cycling, oxygen levels, and algal growth.

Rosi concludes, "Even in small doses, drug pollution in freshwaters can affect organisms, and behavioral changes can have ecological consequences. Understanding how pharmaceutical pollution impacts stream life, and what these changes mean for water quality, ecosystem health, and food webs, is critical to protecting freshwater ecosystems."

Read more: caryinstitute.org/crayfish

CATSKILL SCIENCE COLLABORATIVE **STUDENT PROJECT UPDATES**

The Catskill Science Collaborative (CSC) connects research organizations working in the Catskill region to promote data sharing and collaboration on topics relevant to natural resource management.

The Catskill Research Fellowship program is a CSC initiative designed to fill research gaps identified by natural resource managers in the region. Fellowships are awarded to undergraduate and graduate students. Students conduct research projects with university professors, in collaboration with advisors from natural resource management organizations.

Here's a look at the 2021 projects:

Hanny Mendoza and T.J. McKiernan, both of Binghamton University, are looking at lakes, ponds, and streams in the greater Catskill region to assess their vulnerability to invasive species invasions. Freshwaters in the Catskills provide drinking water to New York City's five boroughs; it is critical to protect them from invasive species that can degrade water quality. Study results will help determine where invasive species prevention efforts might be most effective.

Marissa Kordal of SUNY Cortland is investigating how ecosystem stressors shape tree seedling survival and the quality of soils and water in the Catskill Region. Stressors being explored include white-tailed deer and two invasive species (jumping worms and Japanese stiltgrass). Kordal is assessing impacts individually, and in combination, along a gradient of invasion severity. Insights will help managers choose site-appropriate interventions.

Alison Derevensky of Binghamton University is exploring community engagement in the Rondout Neversink Stream Program. Updates to the Rondout Creek and Neversink River management plans are on the horizon. Derevensky is evaluating outreach methods and working with local stakeholders to determine which communication pathways might best increase participation in watershed conservation efforts.

Kelsey Parker of City University of New York is developing remote sensing methods to assess tree damage caused by hemlock woolly adelgid, an invasive insect, in the Catskills. Parker is using two different types of satellite-based imaging to map distribution of hemlock forest and monitor adelgid-driven decline.

The 2021 Catskill Research Fellowship program is co-funded by the NY State Dept. of Environmental Conservation, the Ashokan Watershed Stream Management Program based at Cornell Cooperative Extension of Ulster County, the NYC Dept. of Environmental Protection, and Cary Institute of Ecosystem Studies.

Alison Derevensky

Fellow Alison Derevensky kayaks the Neversink Reservoir with community members to gauge interest in stream stewardship.

URBAN YARDS CAN PROVIDE **VALUABLE BIRD HABITAT**

Urban birds and yard management were the focus of a recent study co-authored by Cary research fellow Peter Groffman. He was part of a team that explored how differences in residential yard landscaping, and neighborhood features like tree cover and paved surfaces, influenced the presence and diversity of birds in six cities across the US.

Groffman says, "A vast portion of the US is covered by residential land. There is an opportunity to make our yards work better for wildlife. Our results show that yard management designed to enhance wildlife has real effects on birds at both the yard and neighborhood scale."

Cities assessed included: Baltimore, Boston, Los Angeles, Miami, Minneapolis-St. Paul, and Phoenix. In each, the team surveyed birds in yards across four management types: 'wildlife certified' (a National Wildlife Federation designation, often with feeders and native plants), 'water conservation' (with features like rain gardens), lawn-dominant 'high fertilizer', and lawn-dominant 'low fertilizer.' Parks were also sampled in each city.

Bird surveys took place during the breeding season specific to each region. More bird species were found in yards than parks, with parks supporting species of high conservation value, and yards supporting species of public interest (determined using Google search data as an indicator of 'popularity'). Neighborhoods with more trees and less pavement had yards with a higher number of bird species.

Desirée Narango, a co-lead author and postdoctoral researcher at University of Massachusetts, Amherst, says, "Across the cities, wildlife-certified yards and parks supported the most different bird species. This means across a city, yard management can support a wide variety of birds if landscaped for wildlife. The next step is to identify specific features needed by bird species of conservation concern, and help people incorporate these features in their yards."

Bonnie Taylor Barr

Yard management can provide vital refuge for urban birds.

HOW CLIMATE & FARMING **IMPACT SOIL HEALTH**

Soils are home to diverse microbial communities made up of tiny organisms like bacteria, fungi, and archaea. In healthy soils, these microbes are always busy. They trap carbon, cycle nutrients, and support agriculture, allowing us to grow food.

Soils and their many important services are under threat due to climate change, warming temperatures, increased precipitation, and pollution. Agricultural byproducts like fertilizers, manure, and livestock medications present another rising concern. More than seventy percent of antibiotics used today are administered to livestock; much of this is excreted into the environment.

Cary scientist Jane Lucas discussed her work looking at the combined effects of heat and antibiotics on soil microorganisms at the Ecological Society of America's annual meeting.

"Many factors disrupt soil health, but most studies look at the effects of only one variable at a time," Lucas explains. "We wanted to explore the effects of multiple stressors acting on soils simultaneously."

Lucas' team collected samples of native ungrazed prairie soil to test effects of Monensin, a common livestock antibiotic, and rising temperature, on soil organisms. Samples were treated with either a high dose, low dose, or no dose of the antibiotic; these were heated at three different temperatures and left to incubate for 21 days.

Lucas says, "Understanding concurrent effects of multiple stressors on soil microbes is critical to supporting soil health in the face of global change. We saw real changes in soil microbe communities in both the low and high-dose samples. This means that even a small dose of antibiotics can impact soil health. Rising temperature exacerbated these antibiotic effects, with distinct microbial communities emerging at each temperature tested.

We also found that by eliminating bacteria, the antibiotic allowed fungi to dominate, making for less diverse microbial communities. Reduced diversity, and fewer microorganisms overall, makes soils less resilient to future stress. Plus, rising temperatures and antibiotic additions decreased microbial efficiency which can cause soils to store less carbon long term. Ultimately, we found that when soils experience multiple stressors, their ability to maintain their critical functions is hindered."

Dana Whitmore

Jane Lucas collects prairie soil samples in Moscow, Idaho.

SPRING LUNCH

Freshwater is critical to humans and 8 million species on Earth.

Lakes are essential to the water cycle, but pollution, global warming, and inadequate waste systems increasingly threaten lake ecosystems.

Dr. Kathleen Weathers is working globally to understand these dynamics.

Please join us on **April 26** to hear how we harness technology, data sharing, and team science to understand freshwater ecosystems around the world.

For more info, contact Addie at goldfranka@caryinstitute.org

THANK YOU TO THE MARY FLAGLER CARY **LEGACY SOCIETY MEMBERS**

We would like to extend our deepest gratitude to the following individuals, as well as several anonymous donors, for generously including Cary Institute in their estate plans:

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IN CASE YOU MISSED IT

Videos of our virtual events can be viewed online at caryinstitute.org/lecture-videos

Science for the Future of the Hudson River
Cary Science Conversation featuring Cary's Stuart Findlay

NYS Forest Preserves: Balancing Access & Conservation
Virtual panel discussion with Cary's Josh Ginsberg, Catskill Center's Andy Mossey, NYS DEC's Kelly Turturro, and ADK Mountain Club's Michael Barrett

Disease Prediction in a Pandemic Era with Dr. Barbara Han
Cary Science Conversation featuring Cary's Barbara Han

Butterflies & Skippers: Tracking Nature's Clock
Virtual nature walk featuring Cary's Barry Haydasz

Wildfire in the Western US: Causes, Consequences, & Adaptation
Virtual panel discussion with Cary's Josh Ginsberg, Cary's Winslow Hansen, Northern Arizona University's Catrin Edgeley, and University of Montana's Phil Higuera


Barry Haydasz

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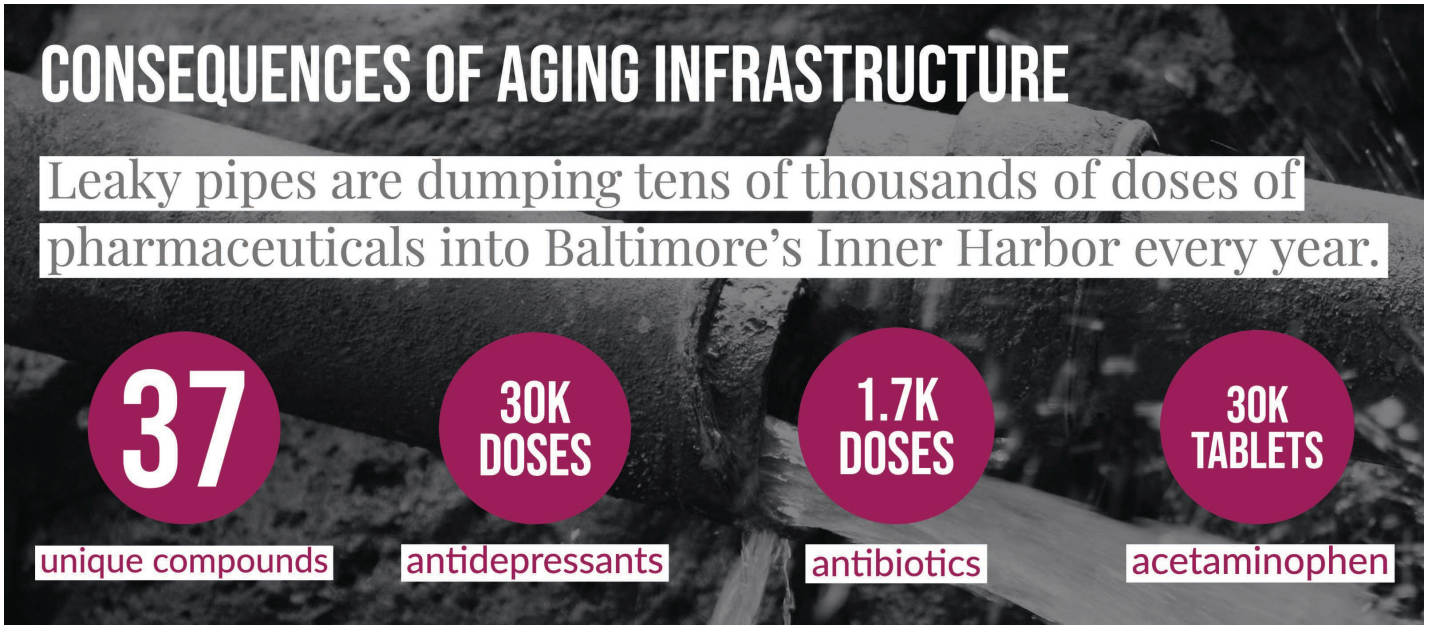

Leslie Tumblety

Pharmaceutical pollution is a growing problem in freshwaters around the world. A new Cary-led study revealed that leaky pipes in Baltimore, MD, are delivering billions of liters of raw sewage to the Chesapeake Bay every year, carrying tens of thousands of doses of pharmaceutical compounds. Effects to aquatic plants, animals, and ecosystem functioning remain largely unknown. Read more: caryinstitute.org/pharma-bes.

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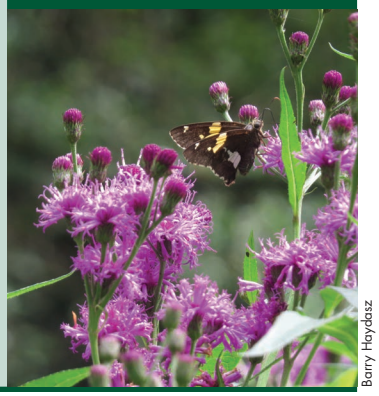

Barry Haydasz

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2021 UNDERGRADUATE **RESEARCH PROGRAM**

Cary's undergraduate research program gives students an opportunity to conduct hands-on research with scientist mentors over the course of a summer. This year, the program ran virtually; students from across the country collaborated with Cary scientists and participated in a range of science skills workshops from afar.

Project topics included: effects of agriculture on soils, forest recovery from fire, the effects of hunting and trapping on North American carnivores, how herbivory patterns vary across the world, and the role of microbial communities in tree decomposition in tropical forests.

Meet the students: (L to R)

Louis Cai, New York University
The legacy of forests past shapes recovery trajectories after fire in boreal Alaska

Alexis Brooke Renata Cambridge, University of Miami
Establishing a key driver in the historical decline and recovery of North American carnivores: Impacts of hunting and trapping

Susan Albor, University of Illinois at Chicago
Soil ecosystems and agriculture: Are manure and antibiotics disrupting soil microbial communities and function?

Kimberly Alexandria Hall, Lander University
How and why plants get eaten differently around the world

Roman Robledo, Massachusetts College of Liberal Arts
Microbial communities from the ground to the canopy: Assessing assembly processes and decomposition in a tropical forest