



# The Cross-Pollinator

*Connecting forested communities & delivering science for the trees outside your door*

## Research That's For the Birds: Protecting Habitats and Ecosystem Services using i-Tree Tools



Wayne Arendt, seated at center, demonstrates bird banding and scientific data collection techniques to local technicians and civic scientists in Santo Domingo's National Botanical Garden. USDA Forest Service photo by Jerry Bauer.

### Learning the Language

In 1976, when a young Wayne Arendt traveled to the Dominican Republic for 2 years of U.S. Peace Corps service, he couldn't have imagined the impact his work would have across the Caribbean and the Americas in the coming decades. Today, Arendt and his research partners at the USDA Forest Service International Institute of Tropical Forestry (IITF), along with several universities and conservation organizations, are helping

to optimize birds' benefits to people and the environment and, along the way, to strengthen international cooperation.

"Back in the 1970s, the Santo Domingo Natural History Museum needed an ornithologist to study local endangered birds," says Arendt, now a supervisory research wildlife biologist for the IITF. "The Peace Corps reached out to the Smithsonian Institution and then the Peace Corps contacted me, as a young ornithologist who was just getting started.

### SUMMARY

Birds are part of the ecological foundation on which all life depends. For decades, USDA Forest Service scientists have studied birds to understand and quantify the far-reaching ways that they affect ecosystem services (life-sustaining and other benefits humans derive from nature) and function as environmental warning systems. This work is expected to become more important in light of increasingly extreme weather events, urban expansion, deforestation, climate change, invasive species, and diminishing biodiversity. This research has recently been integrated with a Forest Service tree and forest assessment tool called **i-Tree**. By combining and augmenting decades of data with this powerful software tool, researchers are now able to create rapid assessments and visual aids that can inform land management decisions across the United States, and globally. Today, scientists with the Forest Service International Institute of Tropical Forestry (IITF) and its partners are using this tool to support land managers and strengthen international cooperation across the Caribbean, Latin America, and North America, including Mexico and Canada.

I didn't speak a word of Spanish and I asked how long it would take me to drive there," he recalls. "The museum hired me despite being geographically challenged. When I got to the island, I took an eight-week crash course to learn the language."



The Cape May warbler provides ecosystem services across its migratory range, from Santo Domingo to the forests of northern Maine and beyond. Of Santo Domingo's 15 most abundant bird species, the Cape May warbler is the only one that is migratory. USDA Forest Service photo by Jerry Bauer.

Since then, Arendt has crisscrossed the Caribbean and Mesoamerica for research and collaboration, with a few adventures along the way. In pursuit of field data, he's been chased by drug dealers, stung by scorpions, and attacked by rabid mongoose, feral bulls, and venomous snakes. He's also trained hundreds of students, researchers, and community scientists in topics such as wildlife ecology, animal survey techniques, and bird identification and study. His research has included identifying stressors affecting critically endangered birds such as the Puerto Rican parrot, using birds as bioindicators of environmental integrity, and finding ways to combine urban bird ecology and research results with land-cover and land-use software.

## Piecing Together Habitat in Urban and Rural Environments

"Birds interact with their environments in ways that aren't always immediately understood or appreciated and they can have a deep impact on human and natural resources," Arendt explains.

For example, birds have important roles in pest control, plant pollination, animal carcass removal, seed dispersal, ecosystem maintenance, coral reef fertilization, and environmental early warning indication. They also provide a sense of place and

heighten appreciation of nature; bird songs are being studied for their contribution to human well-being. As well, they attract and inspire birdwatchers from around the world to support local economies through eco-tourism. In the U.S. alone, bird and related wildlife viewing pumps \$80 billion into the economy annually.

While native birds and pollinators increase the stability and productivity of our ecosystems, they cannot survive without connected corridors of habitat along their entire migratory range—especially at their winter and summer endpoints. Refuges and parks cannot sustain many bird populations sufficiently—the entire system is dependent on the choices that we make in the urban/suburban matrix, in both the tropics and temperate forests.

With all this in mind, and in light of birds' often extensive ranges and migratory patterns, Arendt notes, "Our work has wide implications for conservation across much of the western hemisphere." In fact, about two-thirds of the bird species associated with North American forests live in the tropics for most of the year, returning during the spring and summer to breed. This is why the Forest Service and others work with partners across flyways – ensuring species survival requires a collaborative effort to maintain, manage, and restore habitat over thousands of miles.

Arendt's research partner David King, a research wildlife biologist for the Forest Service in Amherst, Massachusetts, provides a pertinent example: the Cape May warbler (*Setophaga tigrine*). Named after the site where the first specimen was collected in New Jersey, this species actually has a summer breeding range across the spruce forests of northern New England, the Great Lakes, and southern central/eastern Canada. In the winter, these birds can be found in the Caribbean, including in places where you might not expect to see them: urban areas such as Santo Domingo, the capital of the Dominican Republic and Caribbean's largest metropolitan area by population.

Birds and pollinators are part of the ecological foundation on which all life depends – we would be wise to realize that their needs are our needs. "The Cape May warbler is actually one of the most abundant species in parks and gardens in Santo Domingo," King says, adding, "We want to make sure these birds have suitable winter habitat as part of a full life-cycle



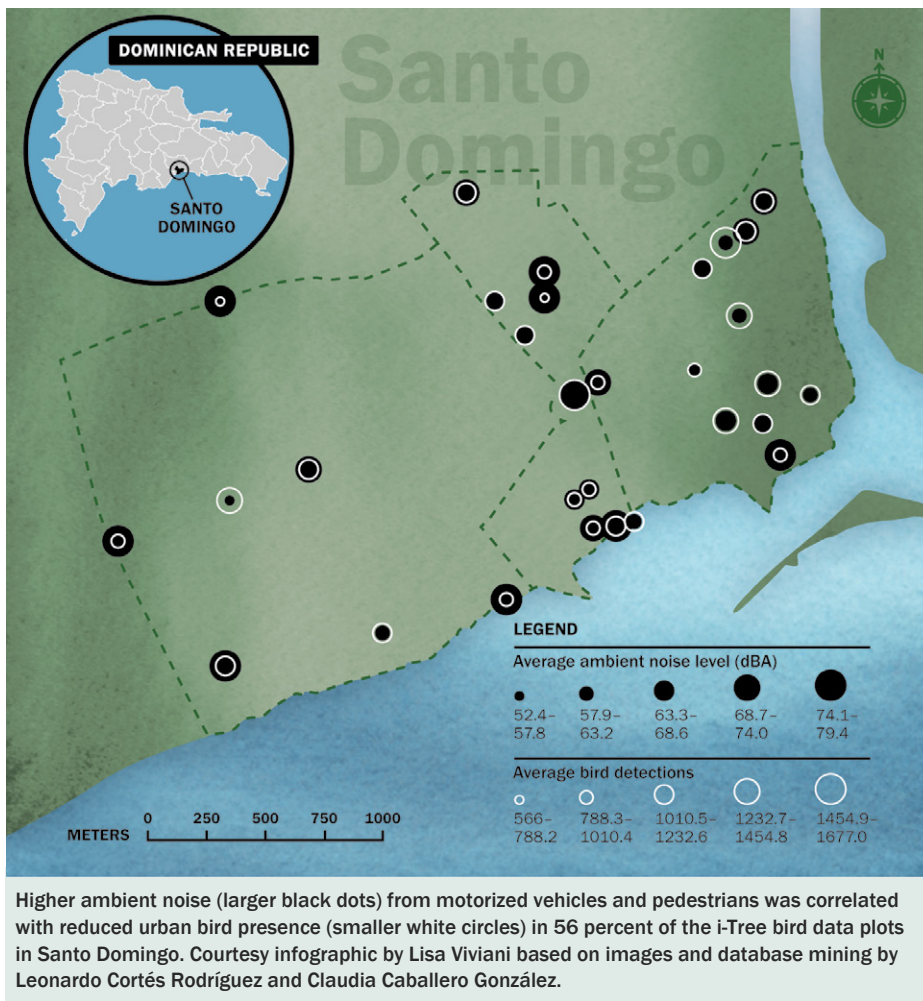
Hispaniola's iconic Hispaniolan parrot has adapted well to urban areas, where it is recognized for its aesthetic and cultural value. USDA Forest Service photo by Jerry Bauer.

conservation approach, not just because it's part of our mission as Forest Service biologists, but because of the services these species provide to society."

King explains that the Cape May warbler has been shown to dampen outbreaks of the spruce budworm, a forest pest that can cause extensive environmental and economic damage to northern North American forests in an outbreak year. According to King, "If Cape May warblers were to lose habitat and fail to survive the winter as a result of drought and lower food abundance in the Caribbean, northern outbreaks like spruce budworm would proceed faster and peak higher." This would result in greater spruce, fir, and other conifer mortality, changing forest composition and impacting everything from timber production to recreation to fire risk.

*"If Cape May warblers were to lose habitat throughout their breeding or wintering grounds, and fail to survive the winter as a result of drought and lower food abundance in the Caribbean, northern outbreaks like spruce budworm would proceed faster and peak higher."*

–David King, Northern Research Station



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—Susannah Lerman, Northern Research Station

models for nine northeastern U.S. species. By combining and augmenting decades of bird data with i-Tree, researchers are able to create and quantify countless targeted assessments, detailed predictions, and visual components that can guide land management decisions across the Northeast. “Our current research is expanding this framework to Santo Domingo and other cities that have collected i-Tree data and bird data,” Lerman explains. “With i-Tree, we have a standardized way of collecting habitat data, plus carbon storage, stormwater runoff, shading potential, species diversity, and placement.” For example, one study helped to quantify and visualize how higher ambient noise from motorized vehicles and pedestrians in Santo Domingo correlates with reduced urban bird presence.

While birds have critical ecological, economic, and social importance, Lerman notes that they don’t always drive decisions related to urban development. Integrating bird data with i-Tree is a way to elevate the needs of birds and the implications of various management decisions on birds. “Having this software as an umbrella to gain habitat protection and enhancement, harness public enthusiasm [and catalyze individual contributions to habitat improvement], and benefit people’s quality of life at the same time—that’s a powerful tool and a big part of the work I do.”

## Using i-Tree

While land managers have seen the value of this work for decades, recent software development has made the research findings much more quantifiable and compelling. Developed by the Forest Service, Davey Tree Expert Company, and partners 15 years ago and steadily refined and expanded since then, i-Tree is a suite of tools that can assess and analyze forest benefits. The suite includes a variety of applications, such as i-Tree Canopy, and i-Tree Eco (both of which can be used internationally) and others. For example, the i-Tree Eco tool combines field data collected from single trees,

complete inventories, or randomly located plots with other data to quantify forest structure, environmental effects and value to communities. Its use has also helped increase data reporting consistency for bird research.

“While compiling data for building the i-Tree habitat models, I noted that bird research was conducted slightly differently by different researchers, even for the same species; this made the data challenging to use,” according to Susannah Lerman, a research ecologist for the Forest Service in Amherst, Massachusetts, and one of Arendt’s research partners. Lerman explains that there are i-Tree bird habitat

## I-TREE

i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment tools. The i-Tree tools are available to download, are free of charge, and can help strengthen forest management and advocacy efforts by quantifying forest structure and the environmental benefits that trees provide. The tools are also educational and informative and can be used by classrooms and anyone who may be interested. Find out more at [www.itreetools.org](http://www.itreetools.org). In addition, a group of partners anchored by the Forest Service are now offering the i-Tree Academy, a three-month online course designed to introduce participants to the suite of i-Tree tools; domestic and international academies are being offered. More information on the Academy is available at: <https://www.unri.org/itreeacademy/>.



## Education and Training: A Virtuous Cycle

A key aspect of the i-Tree/urban bird integration effort has been achieved through extensive i-Tree and field data-collection and education in Puerto Rico and elsewhere. The more people who understand the software and its applications, the more projects and applications can be developed. The results have helped to raise awareness of birds' importance while improving crucial bird habitat and protecting birds' benefits to humanity and the environment across thousands of miles. But more work remains – to integrate more birds over more landscapes.

In addition to the University of Massachusetts-Amherst, key long-term academic partners include the Santo Domingo Institute of Technology and the University of Puerto Rico (UPR). According to UPR Professor Elvia Meléndez-Ackerman, “Our role has been training Caribbean researchers and land managers on how i-Tree can be used and also expanding their knowledge of related resources through our connections.”

Meléndez-Ackerman explained that in 2015, i-Tree team leader David Nowak visited San Juan to conduct training. This started a chain reaction of excitement, innovation, and subsequent trainings that led to i-Tree graduate research projects and targeted data-collection and analysis projects across Puerto Rico and the Dominican Republic. “Once you train a few people, this can multiply,” Meléndez-Ackerman says, adding, “If you can make sure to include academia in some form to lead the efforts and make sure the data are standardized, you have the potential for creating community and academia collaboration. Accomplishing this is a huge step toward accomplishing actual change.”

These Puerto Rico and Dominican Republic i-Tree projects can be applied to urban improvement, environmental justice, green infrastructure, ecosystem services, biodiversity, and climate change adaptation and mitigation projects, to say nothing of their economic applications related to bird-watching and tourism. For example, thoughtful green investments could increase everything from canopy cover to climate resilience and access to biodiversity. In fact, there's such a wealth of applications that it can be difficult



Santo Domingo's Parque Mirador Sur harbors many plants and animals while attracting local residents and tourists. Santo Domingo is the oldest permanent city established by Europeans in the western hemisphere. Courtesy photo by Stiward Montero, Fundación REDDOM/IITF, used with permission.

to choose between them. Meléndez-Ackerman explains, “Trees and forests provide multiple benefits and services. The challenge is to integrate them and to establish priorities. i-Tree is a great resource in helping to understand, quantify, evaluate, and monitor these resources.”

For example, in 2019 Arendt and several research partners published a paper in the *Urban Naturalist* describing how i-Tree and Cornell University's eBird database were used to measure bird data from 80 sites around Santo Domingo. The study found that a bird called the pearly-eyed thrasher (*Margarops fuscatus*) had increased its range onto the Dominican Republic, with potentially harmful impact. This aggressive, opportunistic, and omnivorous bird tends to outcompete other birds, and can disrupt ecosystems and other birds' environmental benefits. In particular, the pearly-eyed thrasher is known to compete with the critically endangered Puerto Rican parrot for nesting sites and may even destroy the

eggs of this species. Urban development, extreme weather, and other stressors may cause this bird to spread to Florida and other southeastern states. The use of i-Tree helped to uncover a problem that can now be a focus for management.

## Opportunities in the Caribbean and Beyond

Tamara Heartsill Scalley, a research ecologist with the IITF, points out that the region's complexity comes with challenges and opportunities that this work can address. As she explains, “The Caribbean region is complex and international, but we have similar forest types and similar disturbances. Understanding the factors for one island can help people understand and connect with other islands.”

With i-Tree, Heartsill Scalley explains, researchers can measure diversity and species richness from urban to rural areas. In addition to highly relevant forest

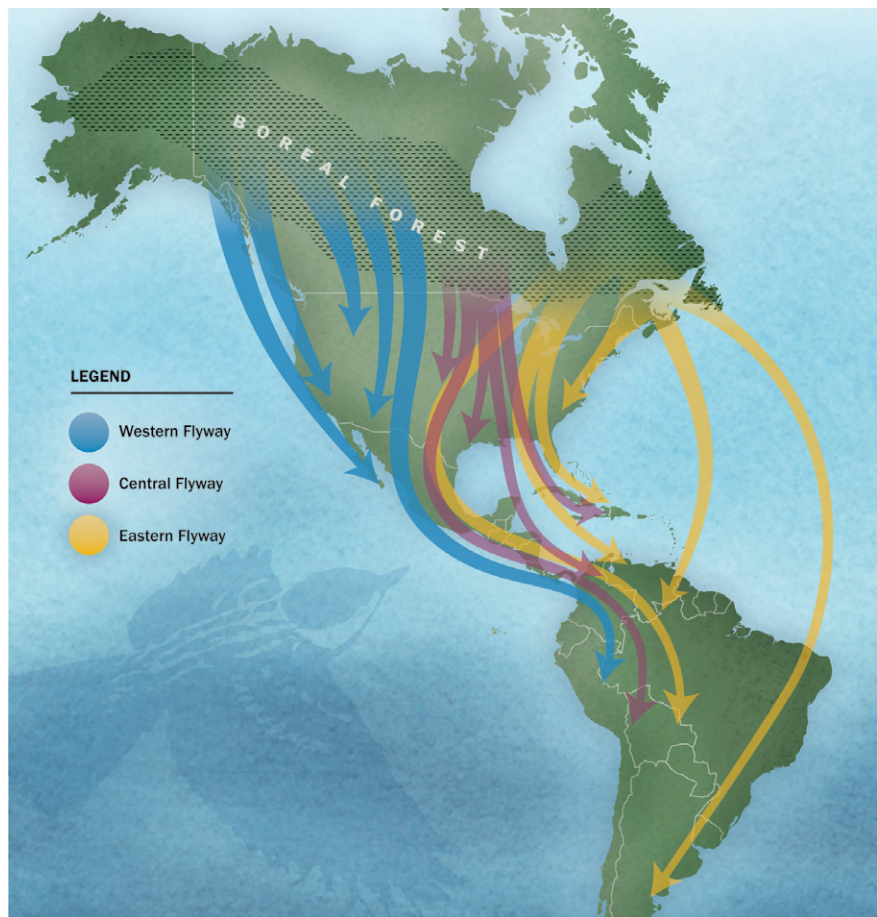
*“The Caribbean region is complex and international, but we have similar forest types and similar disturbances. Understanding the factors for one island can help you understand and connect with other islands.”*

*–Tamara Heartsill Scalley, International Institute of Tropical Forestry*

ecology topics such as biomass damage and regeneration from hurricanes, she says, “We can now use i-Tree to categorize and measure environmental components such as nonnative and native species mix, or which of the identified birds are insectivorous and which are dispersing seeds.”

While much of the Caribbean i-Tree research so far has focused on Puerto Rico and the Dominican Republic, Heartsill Scalley says, “i-Tree’s applications in the Caribbean are increasing almost exponentially because the more we use it, the more we see how it can be tailored for our tropical ecosystem and species. You can scale to a backyard in a city or a park, or a subdivision, then generate similar parameters. You can calculate and compare results for complex and nontraditional forestry areas like cities and suburbs and then communicate it to land stewards with specificity and benefits.” Perhaps even more powerful than leaving the results in the hands of managers and policymakers, this is also a way to engage anyone with a yard in a conversation about the simple steps that they can take to contribute to creating habitat that supports birds.

This improved measurement, quantification, and visualization of birds’ importance has enormous potential not just for the Caribbean region, but for anywhere that birds live. By harnessing decades of data, modern data collection tools, and i-Tree software, this work can serve as a model for other regions across the country and the world. Perhaps to our detriment, we tend to think of conservation happening on an institutional scale—with major decisions that are made by a government or a land management agency. The beauty of these data is that they can certainly have impact at this level, but they also may be used to influence individual decisions. Building better bird habitat literally starts in peoples’ yards. As Heartsill Scalley says, “In the back of our minds, we’re always wondering: How can we apply this elsewhere?”



Each fall, 3 to 5 billion birds migrate south from the North America boreal forest to their wintering habitat, providing many ecosystem services that can be measured by the Forest Service and its partners using i-Tree software. Courtesy infographic by Lisa Viviani based on an image created for Boreal Conservation.



IITF wildlife technicians Maria and Luis Paulino collect bird data at an i-Tree plot in Santo Domingo’s Colonial City. USDA Forest Service photo photo by Jerry Bauer.



Maria Paulino, an IITF wildlife technician, teaches Santo Domingo school children about urban birds and conservation. USDA Forest Service photo by Luis Paulino.

## THE INTERNATIONAL INSTITUTE OF TROPICAL FORESTRY: ISLANDS WORKING WITH ISLANDS

In 1939, the United States was still in the throes of the Great Depression. Following centuries of unsustainable use, natural areas across the Caribbean were severely degraded. The Civilian Conservation Corps had been at work for 6 years, deployed to every state in the Union and to the Virgin Islands and Puerto Rico. In Puerto Rico, the Corps restored natural areas and built roads that provided public access to the forests. In 1939, Congress also funded a Puerto Rico-based research and land management organization to help guide sustainable management of the forests, wildlife, and watersheds of the American tropics.

Today, after 82 years and one name change, the International Institute of Tropical Forestry (IITF) is still guiding research and sustainability efforts and providing related technical and financial assistance in Puerto Rico, the U.S. Virgin Islands, and around the Caribbean and in Central and South America. Via extensive collaboration, deep personal relationships, and hard-earned trust, this Forest Service division continues to have a profound regional impact.

According to Gerald Bauer, the Institute's international cooperation program manager, "The IITF is one of the oldest regional scientific institutes in the hemisphere. For what we do, especially considering our connections with other Federal agencies like the Natural Resources Conservation Service and the U.S. Agency for International Development, we're a model of regional collaboration for the rest of the world."

Bauer describes the Institute's role as including public diplomacy, with a focus on generating and strengthening personal, institutional, and national trust. He explains, "Because we're part of a Federal agency, we have regional credibility. But that's not enough. Because we're based in Puerto Rico, there's a geographic and cultural connection with the rest of the Caribbean, as well as Central and South America."

These connections have resulted in international air quality and climate change studies, green area conservation programs, and even scholarships, doctoral programs and stakeholder training classes. "It's islands working with islands to build relationships and create change based on long-term studies that no one has ever done before," Bauer says, bringing together regional universities, stakeholders, and local land managers while generating public enthusiasm for sustainability efforts. "We're providing high-level research, resources, and technical assistance, but we're also inspiring people to start businesses and training fishermen to be civic-scientists," he says. For example, in the Dominican Republic, civic-scientists are helping the IITF by studying illegal hunting and mangrove damage, seabird die-offs, and more.

IITF initiatives have implications for the rest of the world, not only for cultural and political connections, but for early indicators of environmental changes due to global warming and for regional ecosystem connections such as migratory and urban bird research. They also have increasing importance as the region copes with hurricanes, volcanic activity, urban expansion, deforestation, climate change, and diminishing biodiversity. "There are a tremendous variety of habitats in this part of the world, and you see change faster here," Bauer says, adding, "There's enormous international scientific and cultural potential to our work."



## KEY POINTS

- Birds have significant natural and environmental importance in terms of their ecosystem benefits and as indicators of ecosystem integrity.
- Because of migration, extensive home ranges and habitat diversity, changes to bird habitat in Caribbean urban and rural areas can have significant effects on bird populations as well as their ability to provide ecosystem services elsewhere.
- Extensive Forest Service data are now being integrated with i-Tree forestry analysis and benefits assessment software tools, enabling researchers to better quantify forest structure and value to inform land management and advocacy efforts.
- Forest Service bird research is expected to become even more important in light of climate change, urbanization, and related stressors.
- Using bird research and other areas of study, the International Institute of Tropical Forestry is helping to optimize ecosystem services and strengthen international cooperation across the Caribbean, Latin America, and North America, including Mexico and Canada.

## MANAGEMENT IMPLICATIONS

- The Forest Service has been studying birds and their human and environmental benefits across a variety of ecosystems for decades.
- More recently, the i-Tree software has provided a valuable set of tools to quantify forest structure, environmental effects, and value to communities.
- The combination of Forest Service bird data and i-Tree software by scientists with the International Institute of Tropical Forestry and its partners is providing a range of targeted urban and rural data that can be applied across birds' often wide-ranging habitats and migratory areas.
- Land managers across the Caribbean and the Americas can use this information to help guide management decisions, drive civic-science initiatives, and improve international collaboration.

## FURTHER READING

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## ADDITIONAL RESOURCES

International Institute of Tropical Forestry (IITF): [www.fs.usda.gov/main/iitf/home](https://www.fs.usda.gov/main/iitf/home)

San Juan Urban Long-Term Research Area (ULTRA): <https://sanjuanultra.org>

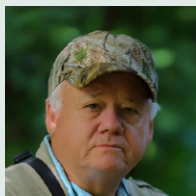
i-Tree: [www.itreetools.org](http://www.itreetools.org)

Taking Flight: Urban Forest Stewardship for Bird Conservation using i-Tree Eco software. Archived webinar available at <https://www.fs.fed.us/research/urban-webinars/taking-flight.php>.

## CONTRIBUTOR PROFILES



**WAYNE ARENDT** is a supervisory research wildlife biologist with the Forest Service's International Institute of Tropical Forestry, based in San Juan, Puerto Rico. His research interests include avian morphometrics, life histories, migratory bird ecology, and population dynamics, maintaining neotropical biodiversity, and combining avian research with urban forestry in cooperation with the U.S. Agency for International Development, Santo Domingo Urban Long-Term Research Area (ULTRA), and the Northern Research Station. Arendt received a bachelor's degree in biology from the University of California at Los Angeles, a master's degree in biology from the University of Missouri-Columbia, and a Ph.D. in wildlife ecology from the University of Wisconsin-Madison. More information on Arendt can be found at [www.fs.fed.us/research/people/profile.php?alias=warendt](http://www.fs.fed.us/research/people/profile.php?alias=warendt).



**GERALD "JERRY" BAUER** is the director of international cooperation for the Forest Service's International Institute of Tropical Forestry (IITF). He provides technical assistance to international aid agencies, not-for-profit organizations and local communities in the areas of biodiversity conservation, climate change, natural resources, environmental assessments, and sustainable eco-tourism. Bauer received a bachelor's degree in forest resource management from Southern Illinois University-Carbondale and a master's degree in international forestry from the State University of New York College of Environmental Science and Forestry. More information on Bauer can be found at [www.fs.fed.us/research/people/profile.php?alias=gbauer](http://www.fs.fed.us/research/people/profile.php?alias=gbauer).



**DAVID KING** is a research wildlife biologist with the USDA Forest Service in Amherst, Massachusetts. His research studies include the effects of habitat restoration on breeding prairie warblers, habitat-specific abundance, and survival of wintering migrant songbirds in the Caribbean, Honduras, and Belize, the effects of urbanization on forest birds, and developing market-based approaches for forest conservation in Latin America. He received a bachelor's degree in wildlife management from Humboldt State University, a master's degree in wildlife and fisheries conservation, and a Ph.D. in wildlife and fisheries conservation/organismic and evolutionary biology from the University of Massachusetts. More information on King can be found at [www.nrs.fs.fed.us/people/dking](http://www.nrs.fs.fed.us/people/dking).



**SUSANNAH LERMAN** is a research ecologist with the USDA Forest Service in Amherst, Massachusetts. Her research, which highlights strategies and tools for reconciling urban development with biodiversity conservation, uses a socioecological approach to improve fundamental understanding of key ecological processes in human-dominated landscapes, with a focus on birds, pollinators, and ground arthropods. Lerman received a bachelor's degree in American history from the University of Delaware, a master's degree in conservation biology from Antioch University New England, and a Ph.D. in organismic and evolutionary biology from the University of Massachusetts. More information on Lerman can be found at [www.nrs.fs.fed.us/people/sblerman](http://www.nrs.fs.fed.us/people/sblerman).



**ELVIA MELÉNDEZ-ACKERMAN** is a full professor of environmental science at University of Puerto Rico, Río Piedras, and a co-principal investigator for San Juan Urban Long-Term Research Area (ULTRA). Her research focuses on plant ecology and evolution, bioconservation, urban ecosystem services and social-ecological implications of this research. She received a bachelor's and master's degrees in biology from the University of Puerto Rico, Río Piedras, and a Ph.D. in ecology and evolution from the University of California, Irvine. More information on Meléndez-Ackerman can be found at <https://natsci.uprrp.edu/tropiecolology/people-1>.



**TAMARA HEARTSILL SCALLEY** is a research ecologist with the USDA Forest Service International Institute of Tropical Forestry, based in San Juan, Puerto Rico. Her research focuses on the ecology of tropical forests, particularly community composition responses to disturbance and long-term dynamics of permanent forest plots in the Caribbean. She received a bachelor's degree in geography and a master's degree in biology from the University of Puerto Rico at Río Piedras and a Ph.D. in ecology from Utah State University. More information on Heartsill Scalley can be found at [www.fs.fed.us/research/people/theartsill](http://www.fs.fed.us/research/people/theartsill).



#### WRITER'S PROFILE

*BRIAN COOKE is a contract science writer for the USDA Forest Service. Cooke has a degree in journalism-science writing from Lehigh University. In addition to writing for the USDA Forest Service, Cooke has completed writing assignments for the National Park Service, History Colorado, and various environmental services companies.*

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#### PURPOSE

The Cross-Pollinator is a science synthesis publication produced quarterly in cooperation between the Northern Research Station, the Urban Field Station Network, State and Private Forestry, and the Urban Forest Technology and Science Delivery Team. It spotlights transdisciplinary collaborations among researchers and practitioners that “cross” forest research with urban and community forests at a landscape scale.

#### ABOUT US

The mission of the Urban Field Station Network is to improve the quality of life in urban and urbanizing areas by conducting and supporting research and science exchange about social-ecological systems and urban-to-rural resource management. The mission of the Urban Forest Technology & Science Delivery Team is to work collaboratively to deliver quality urban natural resources science, technology, and information to improve the long-term sustainability of urban ecosystems and the broader watershed, for wildlife and people. Find out more at <https://www.nrs.fs.fed.us/ufs/>; <https://www.fs.fed.us/research/urban-science-delivery-team.php>; and <https://www.vibrantcitieslab.com/>

#### CONTACT INFORMATION

For more information or to sign up to be notified of future issues, visit <https://www.fs.fed.us/research/cross-pollinator/>. For questions, comments, or feedback, contact the editor:

Sarah Hines  
Urban Field Station Network Coordinator [sarah.hines@usda.gov](mailto:sarah.hines@usda.gov)

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