City Scanners

Snakefly (family Inocelliidae)

CITIZEN SCIENTISTS PARTNER WITH A MUSEUM TO TRACK INSECT BIODIVERSITY IN LOS ANGELES.

By Emily Hartop

Fruit fly (family Tephritidae)

KELSEY BAILEY

A mere one hundred fifty years ago, Los Angeles was little more than a small pueblo. The city grew rapidly, often carelessly, with unbridled hubris and an expectation that nature could be mastered. Today, however, some of the many derogatory stereotypes of L.A., as a mecca of cultural superficiality or an environmentally unfriendly smog zone, may finally be on the way out. There are growing numbers of Angelenos who want to make sure the environmental recklessness of the city's early years doesn't continue, people who value the chance to kayak the L.A. River, hike in Griffith Park, surf the Pacific, or watch butterflies and bees in their own backyards.

The first priority in the fight to counteract fast-paced urbanization is to determine what previous attempts at "mastery" over nature have wrought upon local ecosystems. What patterns of biodiversity exist throughout the city, and how can those be quantified, protected, and strengthened? High levels of biodiversity usually indicate good overall health of an ecosystem, but in a sprawling metropolis like L.A. the issue is particularly complex. A variety of habitats surround the city, from mountains to desert to chaparral to ocean; the latter is home to the two largest container ports in the country (the Port of Los Angeles and the Port of Long Beach). Those ports bring in necessary commodities for the region along with a fair share of tagalong nonnative species. Add to that the ease of modern travel, and you have a recipe for unprecedented intercontinental exchange of species in the city.

To begin tackling questions of biodiversity, scientists at the Natural History Museum of Los Angeles County (NHMLAC) enlisted the help of citizens—interested naturalists—across the city in a study called Biodiversity Science: City and Nature, or BioSCAN for short. The study was initiated by my colleague Brian Brown, the curator of entomology at the Museum, after findings in Brown's own backyard piqued his curiosity. The BioSCAN project harnesses insects as tools to explore urban biodiversity, relying on an array of thirty trapping sites across the city, mostly in private backyards. Insects have rapid lifespans and small home ranges, allowing researchers to examine their city's biodiversity at the neighborhood level—a completely different perspective from that of urban biodiversity studies based on birds or reptiles with much longer lifespans and larger ranges.

All participating residents agree to a three-year commitment, during which time they host a large netted trap designed to catch flying insects called a Malaise trap [*see image on right*] and an accompanying weather station in their backyard. The thirty sample sites cut a twelve-mile-long swath

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Lush Los Angeles retreats (the backyard of Glen Creason, right, and the Union Avenue Cesar Chavez Community Garden, above left) serve as collection sites for the BioSCAN project—a sampling of the city's insect life that gauges urban biodiversity and assesses the balance between endemic and introduced species.

across Los Angeles, west of the I-110 freeway that runs through the city center. The sites range from yards adjacent to L.A.'s surrounding open spaces to others tucked deep within the urban core of the city. Every week samples are collected from the sites, and staffers at the Museum sort the insects to Order (the taxonomic level where one separates, for example, the bees from the butterflies). Much of this higher-level sorting akes place in the museum's "Nature Lab," an interactive center on urban wildlife—allowing the public to see real specimens from their own neighborhoods. An army of undergraduates and volunteers, dozens strong, carries out the initial processing; then target groups are sorted further and examined in a variety of research inquiries.

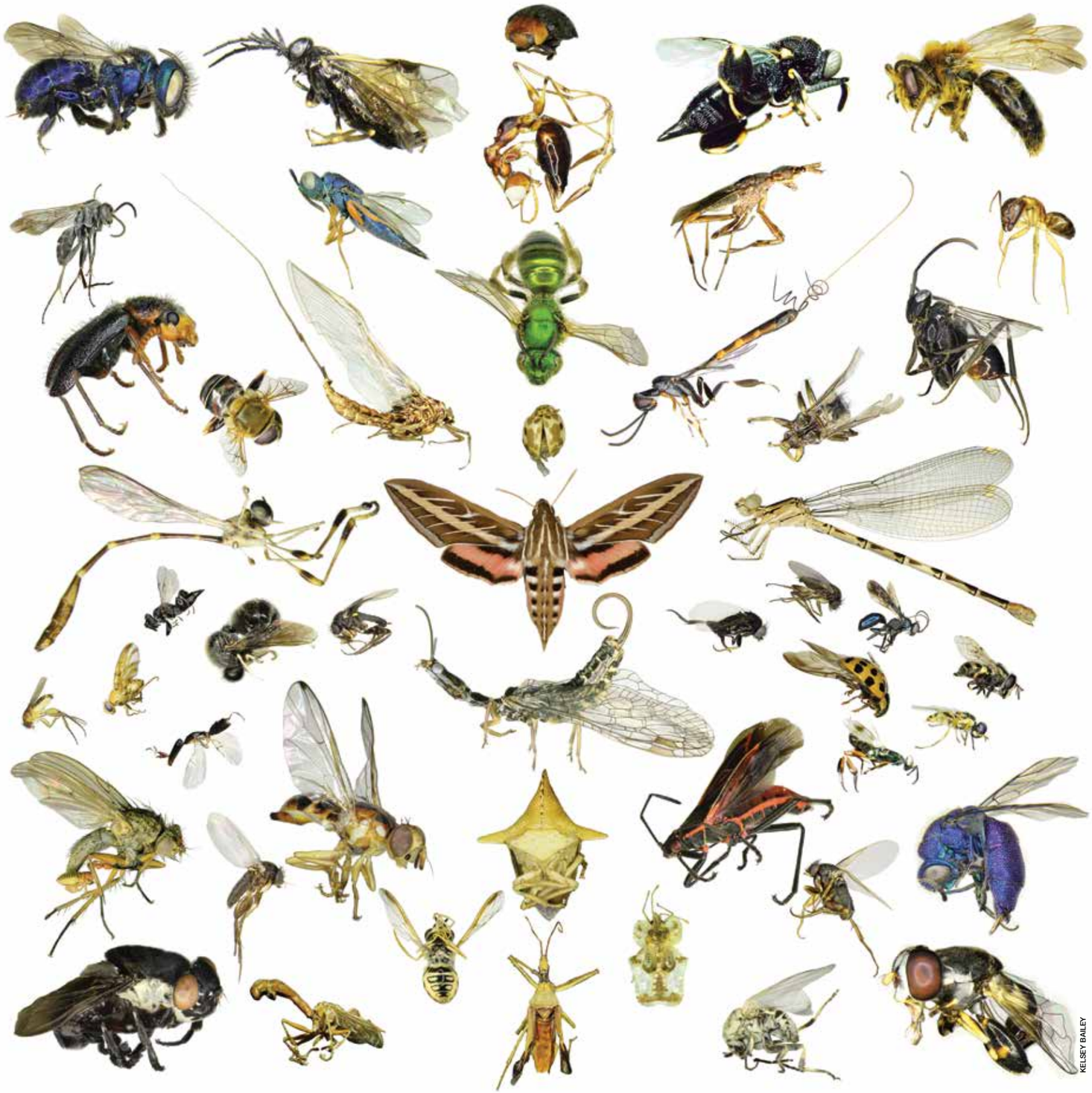
BioSCAN scientists ship specimens to scientists around the world for collaborative and comparative results, contributing to a growing regional, national, and even global understanding of biodiversity. Another ambitious feature of this project, thanks to its home base in a research museum, is that all of the BioSCAN samples are being amassed into a professionally curated collection that will be available for scientific research for years to come.

WITH BioSCAN, we are slowly unraveling the stories of the insect fauna of Los Angeles. Which insects have always been here, which did we purposely introduce, which are we just now discovering that have recently arrived on their own? When narratives such as those are distilled from a bottle of preserved insects from a host's backyard, the impact is powerful. Everything is intimately connected; plants in the participants' backyards might be hosts for all of these different creatures, and everything the homeowners do affects their backyard ecosystem. With data from the sites, we make comparisons: are we seeing these insects in other traps from other neighborhoods? What is the life history of this insect, and how is urbanization affecting it?

We are finding insect species that were previously recorded only from places as far-flung as Europe, South America, and even the Seychelles in the Indian Ocean. Inevitably, we're also finding new species. Because of the astounding diversity of insects, we cannot possibly identify every specimen to the species level, but we do have some focal taxa that are receiving special attention. One example is a large family of small flies, the Phoridae: in just one genus of phorids, *Megaselia*, we have discovered dozens of new species in only three months of samples—hinting at the enormous undiscovered diversity that exists even in the heart of one of the world's largest cities. Because certain phorids parasitize particular species of ants, we can also make deductions about the presence of other insects in the area. For other taxa, BioSCAN scientists are hard at work researching literature and collaborating with specialists around the world to identify and describe the new and introduced species.

Even revelations concerning common local species can be exciting. When a site host learned that BioSCAN had been finding *Conicera tibialis*, the coffin fly, in his backyard, he e-mailed excitedly, telling us that his deceased pets were buried there—eager to offer a possible connection. Site hosts are particularly excited to learn about insects like this, with unusual life histories. We are thrilled when we can tell residents what we are finding in their own traps, be it a new species or one introduced from halfway across the world. We do this by inviting hosts into the Museum labs, to demonstrate exactly what happens to the samples when they leave their backyards across the city and to tell them what their samples reveal.

Although the specific reason behind each site host's commitment varies, everyone in the project has not only shown diligence in changing out the weekly sample bottles, but an overwhelming enthusiasm for their backyard biodiversity. Eric Keller, whose backyard is in the northeast neighborhood of Eagle Rock, offered his yard as "a service to science." Not far away, another site host, Candace Franco from the neighborhood of Highland Park, joined BioSCAN to introduce her young daughters to scientific research [*see photograph page 32*]. Franco wanted them to have science "in their home and daily routine," and to foster an "interest in science through curiosity in our environment." Site host Glen Creason, the map librarian at the L.A. Public Library for the last twenty-four years, was born in L.A. in the 1950s and has lived there since; he wanted his neighborhood of Glassell Park represent-



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A selection of the range of insects captured in L.A. since the inception of the BioSCAN program in 2012, and cataloged by volunteers and researchers at the Natural History Museum of Los Angeles County.

ed in the study so that he could learn about biodiversity in his own neighborhood [*see photograph on opposite page*]. Because he's seen a lot of changes made with "disregard for the natural Los Angeles," Creason says he wants to help change the course of his city. Without exception, the hosts recognize the importance of what they are doing, and participate with a genuine interest in what BioSCAN might tell them.

Even in small ways, hosting a BioSCAN site changes the way host citizens think about biodiversity. A number of BioSCAN site hosts have confessed to initial attitudes toward insects ranging from a mild aversion to outright fear. Creason found insects fascinating but "still held the 'eww' factor inside." Recently, though, he told me had willingly touched a pet tarantula! So it does seem possible to change attitudes, offering education as an antidote to fear.

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Candace and Giovanni Franco—along with their two daughters—offered their Highland Park backyard as a site for a netted trap. The Malaise trap, pictured behind them, catches a wide range of flying insects that entomologists can use to localize populations.

THE dichotomy between "natural" and "altered" environments has become obsolete, especially in the study of urban environments. Every environment has in some way been altered, and how to define "natural" across the gradient of alteration can be baffling, not least because urban areas are in a constant state of flux. As the density of people changes, the amount of hardscape, artificial lighting, and pollution shifts, along with the composition of flora and fauna. It isn't a question of whether or not to urbanize, it's a question of *how* we are urbanizing, and the citizens of a city play a big part in the "how." Patios, backyards, and balconies all offer choices to be made that affect biodiversity. Choices of what to pave or what to plant. Choices of how often to water. Choices about what to spray or how to light. As much as we may tend to think otherwise, we don't live as separate entities alongside our urban ecosystems. We are an integral part within them.

As site host Eric Keller eloquently stated, urban biodiversity "illustrates the amazing resilience of natural systems and their ability to adapt to rapid environmental change, as well as how some parts of the system fail to keep up with the effects of urban growth." Although some people might dismiss the importance of citizen-cultivated yards compared to spaces controlled by city planners, architects, or landscape designers, the fact is that 42 percent of urban L.A. County is zoned as "single family residential."

One of the most pressing issues in urban biodiversity involves negotiating the balance of native versus imported flora and fauna. Biodiversity becomes biologically, culturally, and socially muddled when imported plants or animals are part of a society's story—even though those imports might be catastrophically destructive to an ecosystem. Case in point: bluegum eucalyptus trees, native to Tasmania and Australia. The species was introduced to California in 1856. As a child, I saw and smelled those wonderful trees lining the cliffs of Malibu where my grandmother lived. They were in my neighborhood and at my schools. I have a love and nostalgia for those trees, which grow in immense groves along the coast, even though my ecological understanding of them as an adult biologist tells me that they are dangerous and destructive.

Imagine an L.A. without palm trees, or a Southern California without citrus. Those trees are iconic to the region, ingrained in the hearts and minds of residents, and—ultimately—economically paramount. Citrus built not only an industry, but countless local communities. Palm trees define the L.A. skyline. Yet citrus is nonnative to the entire United States, and California has but one native palm—and it's not the iconic palm lining the boulevards. Los Angeles would not be the same without its many, many nonnative plants. Many of these plants inevitably, but accidentally, brought with them entire communities of associated insects. For instance, avocados from Mexico introduced the Persea mite (*Oligonychus perseae*) and avocado thrips (*Scirtothrips perseae*) to California. And in 2008 the Asian citrus psyllid (*Diaphorina citri*), a vector for a highly destructive bacterial disease known as citrus huanglongbing, appeared in southern California; the first case in L.A. appeared in April 2012 on a pomelo tree with a lemon graft in the Hacienda Heights neighborhood on the eastern edge of the city. If *D. citri* moves out of the city and onto citrus farms in California, the state industry could quickly collapse.

LISA GONZALEZ

Site host Glen Creason admitted to having reservations about the "eww factor" of insects, yet has had a change of heart.

The story of a person is powerful, and the story of a city is the story of all the people who built and occupy that city. Biological issues in an urban context cannot be looked at outside of a societal and cultural context. Conversely, societal and cultural issues cannot toss aside important ecological issues—we're all in this together. Having informed citizens who are interested in biodiversity is therefore not merely a benefit, it is essential to the improvement of that biodiversity. BioSCAN has made one thing clear: local naturalists are the best allies, most helpful resource, and most complex variable. You simply cannot separate people from wildlife when studying urban biodiversity. Just gathering raw data, insect counts in a spreadsheet, isn't good enough. To be effective, urban researchers must also study how people are constructing their city—and, critically, reflect their work directly back to the people they are studying.

BEYOND backyards, offering tangible suggestions for citizens and city councils will require understanding how factors of urbanization affect biodiversity. The BioSCAN project aims to do this by relating physical and landscape parameters to biodiversity differences across an urban setting. BioSCAN scientists will translate results obtained from "enigmatic" taxa—groups of sparse species and uncertain kinship—to a deeper understanding of how changes in diversity affect urban ecosystem services.

The solution will ultimately need to take into account sociological, economic, and educational angles, and involve collaborations among scientists, urban planners, and (perhaps most importantly) citizens. It's a conversation that needs to go beyond city hall and involve academia, grade schools, local nonprofits, conservation organizations, and museums. Carelessly done, urbanization takes away our access to nature. Access to natural places and enjoyment of uncultivated (or mindfully cultivated) surroundings should be a right of every citizen. We have a right to be healthy and happy, and biodiversity is essential for both. Here in Los Angeles, we have aspiring naturalists living next door to those infamous aspiring actors and screenwriters. The community is building, the science is happening, and we are well on our way to a new era of urban living. BioSCAN will not have all the answers, but it offers a model of research that could be emulated worldwide: a study of urban biodiversity that incorporates the most important factor in the equation—the citizens of the city.

California native **Emily Hartop** is assistant collections manager in the entomology section of NHMLAC. She has both a degree in entomology and a culinary certificate, but keeps her two loves separate (no entomophagy for her). She shares a home in Long Beach, California with her partner, Frank Ortiz, and her cat, Nekochan. She loves reading, camping, and studying fly genitalia. Updates about the project can be found at http://research.nhm.org/bioscan/bioscanbuzz.