# *WINGS*

## ESSAYS ON INVERTEBRATE CONSERVATION

THE XERCES SOCIETY SPRING 2023

# CONTENTS

At the core of wildlife conservation is the need to ensure that animals have somewhere to feed, breed, and shelter—that is, habitat. Making that habitat the best it can be may mean balancing many issues, which sometimes include human needs. In this issue of *Wings*, our writers consider the challenges of light pollution, honey bees in North America, and facilitating agriculture in urban areas.

# Conservation Takes More than Science

*Scott Black*

Invertebrate conservation depends on science, but science alone is not sufficient. We can study every aspect of an insect's life history, discover the threats to its survival, and even recognize what is needed to counter those threats, and still watch it slide toward extinction. Scientific understanding is not enough. For the Xerces Society, the goal is not just to learn about these animals, but to conserve them—and to do that we need to change human behavior. Xerces is fundamentally a partnership organization that draws together people and science to achieve lasting change.

Conservation science is, of course, central to our holistic approach to conservation. You cannot devise solutions without knowing the animals and the issues that impact them. We work with academic researchers, public agencies, and private landowners on a variety of topics. Xerces staff members have been authors or co-authors on more than two hundred peer-reviewed research papers—ranging from the assessment of species and their declines, to understanding the presence of pesticides in our environment, to the testing of practices for habitat restoration. We also conduct surveys of invertebrates and their habitats to inform the place-based management that is essential for our most imperiled species. Additionally, through programs that include the Thanksgiving and New Year's counts of western monarch butterflies in California; our bumble bee atlas projects, now in fifteen states; and Bumble Bee Watch and the Firefly Atlas, both covering the United States and Canada, we harness the willingness of volunteers to obtain valuable data. The information they gather is an important tool that

**Research informs the efforts needed to protect insects and their habitat. Photograph courtesy Mahan Rykiel Associates.**

helps guide our work in education, outreach, technical assistance, policy making, and advocacy—and our volunteers themselves often become powerful advocates for the animals they love.

Regardless of the specific issue, we certainly want people to appreciate insects rather than fear them, and to understand just how vital they are for pollination, as well as for nourishing birds and fish, for building soils, and ultimately for sustaining life on this planet. But appreciation is not enough. We need people to act to protect these animals and their habitats, and to become active in educating others and helping change their behavior as well. Can we persuade folks to stop using toxic insecticides that kill these animals? Can we get neighborhoods to install wildlife-friendly lights? Can we take some of the forty million acres in turf and return them to a more natural environment? Can we help farmers to grow food in a way that is compatible with wildlife? Beyond individual actions, we also need to persuade our local, state, and federal governments to step up. The issues are of critical importance and are becoming ever more urgent every day.

Some of the concerns we address, such as the ones described in the articles in this issue of *Wings*, are not ones that I would have thought of when I began my career. As we have learned more about insects such as fireflies and moths, for example, we now understand just how important it is to talk to people about the impacts of light pollution and the need to protect darkness.

I also never imagined that I would have had to answer so many questions about honey bees. These remarkable insects are negatively impacted by everything from pesticides to lack of flowers. It is important to maintain hives for pollination of large-scale crops such as almonds, but honey bees are not native to North America and are not endangered. Keeping honey bees to help other pollinators is like keeping chickens to help save songbirds—it does not make sense from a conservation perspective. Rather, our efforts should focus on ensuring that there is adequate healthy habitat for all pollinators.

Promoting diversity, equity, and inclusion has become as important as any other aspect of our work. To conserve biodiversity and address the climate crisis, all people need to be actively seen and engaged as part of the solution. The conservation community—Xerces included—has much to do to ensure that people of color and other marginalized groups feel welcome to participate in our work. We must also practice reciprocity to ensure that we are showing up for our partners and expanding our partnerships equitably.

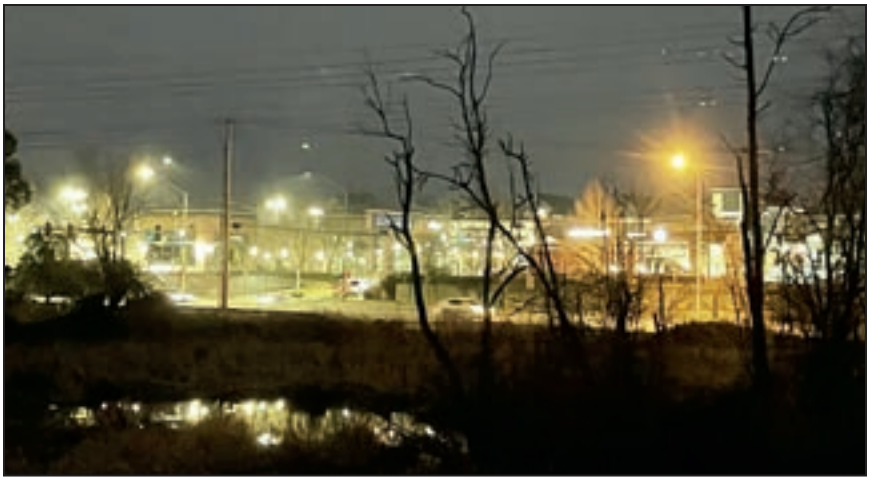
Our holistic approach does lead to success. With partners, we have protected and restored over three and a half million acres of habitat for insects and other invertebrates, and have improved management on tens of millions more. Communities have banded together to reduce pesticides or launch advocacy campaigns. Whether it is persuading people to reduce outdoor lighting or collaborating with urban farmers, we accomplish our mission through the participation of tens of thousands of individuals who act to better the lives of invertebrates and the other animals—including humans—who need the services they provide. I hope that we can count you as part of this movement.

# Embracing the Dark: Insects Need the Night—and So Do We

*Richard Joyce*

Fireflies transformed my relationship to darkness. At some level, I knew that artificial light at night affects insects, but focusing my attention on fireflies as a conservation biologist at Xerces has made me notice light pollution and crave darkness in, well, a new light. Last year, I conducted more than twenty nighttime firefly surveys in five states. As part of each survey, I scanned the habitat and skyline for sources of artificial light. I found that, in some form or another, it was nearly ubiquitous. At the edge of a pond in the Blue Ridge Mountains in South Carolina, I saw skyglow above the tree line, a yellow haze from towns in the distance. A lit-up sign welcoming tourists to a coastal Florida town shone like a beacon into an otherwise dark mangrove swamp. In a salt marsh in Delaware, streetlights at a boat ramp and floodlights at a marina shone like outsized planets on the horizon. In a county park in Georgia, lights in the neighboring streets and houses scattered jagged patches of yellow and white onto shrubs and the forest floor. At times I had to squint or avert my gaze from glare—the harsh, direct light from vehicle headlights or illumination spilling from a poorly shielded streetlight. I still found fireflies during these surveys—often rare, habitat-specialist species—but I couldn't help but wonder how the encroaching artificial light was affecting these bioluminescent beetles.

**Fireflies are a group of insects that rely on the correct level of darkness for their survival. Flashes from mysterious lantern fireflies, photographed by Radim Schreiber.**



**Wetlands are often protected, but nighttime lighting can greatly extend the disturbance caused by nearby developments. Photograph by Matthew Shepherd.**

And where is the tipping point, the level of artificial light at which the night simply becomes too bright for fireflies?

For insect lovers like myself, artificial lights are both a boon and a source of worry. A porch light can gather fantastic creatures at our fingertips: moths of all shapes and sizes, shiny beetles, mysterious wasps. And indeed, light traps are an important tool for studying the diversity and abundance of certain insect groups; it is hard to imagine mothing as an activity without the help of lights. But lights across our landscapes are doing insects a disservice, causing disorientation and distraction. There is research that indicates that lights may disrupt monarch butterfly migration by triggering movement at night when the butterflies would otherwise be resting. While positive phototaxis, or "flight to light" behavior, is one of the more obvious impacts of artificial light on insects, it is worth noting that the opposite (being repelled away from lights) or even an indifference to artificial light (being neither attracted to nor repulsed by it) have their own negative effects. Repulsion can reduce the area of habitat that is effectively available to a species, and indifference can lead to insects remaining in areas where their survival and reproductive rates are affected by increased predation or ineffective courtship behavior.

In the past year, I have repeatedly turned to the research and writing of Avalon Owens, a biologist who recently completed her PhD dissertation at Tufts University on the impacts of nighttime artificial light on fireflies. She has placed firefly pairs in chambers with varying amounts of artificial light to see whether they will mate, put fireflies under lights of different colors to see whether they will flash, and marked fireflies with fluorescent powder to see whether they move away from artificially illuminated areas of a field. She has found that artificial light can dramatically interfere with firefly behavior, but also that not all firefly species respond equally and

that effects on fireflies depend partly on the intensity and color of light. Fireflies whose courtship displays happen at dusk, for example, seem to be relatively tolerant of artificial light, and may even extend their display period in areas where light pollution leads to nights of perpetual twilight. In contrast, fireflies that display later in the evening are likely less adaptable to excess light in their habitats.

Owens and her colleagues have also sifted through the growing mountain of literature and have laid out mechanisms by which artificial light affects the lives (and deaths!) of insects, often using fireflies as case studies. The negative effects include disruptions to navigation, circadian rhythms, and recognition of visual cues; increased vulnerability to predation; and desensitized vision.

While we are still learning about how nocturnal insects see the world, we can make a few generalizations. Like humans, diurnal insects such as bees and butterflies tend to have three types of color receptors, whereas many nocturnal insects, including fireflies, mosquitoes, and cockroaches, seem to have just two, trading color discernment for better night vision. (Moths, which may be day or night active, usually have three.) Most insects can see a similar range of colors as we do, but also ultraviolet, the shorter-wavelength light that is invisible to humans. Compared to other wavelengths, ultraviolet light tends to have the strongest pull on nocturnal insects, for reasons that we still don't fully understand. On the other end of the light spectrum, most insects are either unable to see the longer red wavelengths, or are relatively insensitive to them.

Fireflies and moths see the world differently from the way that humans do, but we can still empathize with how detrimental light pollution can be for them. If you have ever been temporarily blinded by headlight glare, had your sleep disrupted by the blue glow of a computer screen, or gotten a headache from a flickering overhead lamp, you know that the wrong amount of light at the wrong time and in the wrong place can harm your health and happiness. Imagine starting a conversation with a romantic interest, only to have one or both of your voices drowned out by loud noise or competing conversations. Is that the frustration a firefly feels when

**Even low levels of artificial light may be glaringly bright and disruptive to insects with sensitive night vision, such as cockroaches. Photograph by Bryan E. Reynolds.**

its courtship light signal is lost in a flood of artificial light?

Just as with humans, the hormone melatonin plays an important role in regulating the circadian rhythms of insects, letting them know when to seek refuge and rest, when to forage, and when to find a mate. Melatonin is produced in response to darkness, but is regulated by exposure to blue (shorter wavelength) light, which is becoming more abundant at night due to the proliferation of cool white LEDs. At the scale of years and months, insects also use day length (photoperiod) and moonlight as cues for the timing of developmental and reproductive processes. When those cues are altered or obscured, the calendars that they have evolved to follow get thrown off.

Sources of artificial light may vary greatly in the mix of wavelengths that they emit, and their ecological impacts have changed over the years as lighting technology has evolved. While LED bulbs tend to give off much less heat than their predecessors—leading to fewer moths being toasted by sizzling streetlights—their extreme brightness, broad spectrum of wavelengths, and significant short-wavelength component mean that they are more visible to and more disruptive of many different organisms. LED bulbs have notable benefits from reduced energy use and cost that make them a distinct step forward from older bulbs, though their efficiency and low cost means that it is cheaper than ever to dilute the darkness.

So where to begin in tackling the issue of light pollution and its impact on insects? It can help to start small and work outward. Step outside after dark and look at your home or workplace. Light is often necessary for safety, security, and convenience—but does illumination extend to places where it serves little or no purpose? Are lights reaching natural areas, or visible from them? Are porch lights shielded and turned on only when needed, perhaps with the aid of a timer or motion sensor? Can

**Loss of darkness is incremental, with seemingly benign things such as a string of garden lights having a profound effect. Photograph by Matthew Shepherd.**

you use bulbs that are dimmer or less white? Does the string of lights around your patio need to be on all night? Are decorative lights limited to those parts of your garden and to the seasons where their impacts on wildlife will be minimized? Do you need to install curtains or remember to close them so that indoor light stays inside? It is important to treat darkness as the renewable but finite and sensitive resource that it is.

Addressing light pollution and its harmful ecological effects will, however, require action beyond our homes and yards. A growing number of towns and counties have adopted lighting regulations and building codes that aim to minimize skyglow, glare, and light trespass (the shining of light beyond its intended target). Are the policies in your community and region adequate? Are they keeping pace with changing technologies? Do they take into consideration the nuanced impacts of light pollution on wildlife, in addition to its effects on people? Sometimes the barriers to darker nights are simply design problems, but human psychology and sociology matter, too. Helping people—all people—feel safe without brightening the night is just as important as developing technical and regulatory solutions.

The good news is that there is increasing recognition of the importance of protecting the night as people realize what is at stake. Astronomers have long been vocal about light pollution diminishing the view of the night sky, and there are already established efforts to reduce light impacts. In Florida, for example, coastal communities are using public-education campaigns, local ordinances, and red filters to prevent hatchling sea turtles from crawling inland instead of toward the ocean. The state has more firefly species than any other, and it would be simple to expand these approaches to help insects. Lights-out initiatives are taking hold in cities across the country, with skyscrapers and other structures voluntarily dimming or shielding lights to protect birds during migration; in New York City, even the World Trade Center memorial participates. These efforts, while still somewhat incipient, help to raise public awareness and to demonstrate what might be possible with attention, collective will, and creative engineering. It is important that we harness the momentum of these actions to further protect darkness and the insects that rely on it.

**Reducing outdoor lighting will help moths that are active from dusk to dawn. White-dotted prominent, photographed by Bryan E. Reynolds.**

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*Richard Joyce is an endangered species conservation biologist with Xerces. He collaborates with researchers, land managers, and community scientists to drive firefly conservation efforts, and coordinates the Firefly Atlas.*

# Want to Save the Bees? Focus on Habitat, Not Honey Bees

*Rich Hatfield and Matthew Shepherd*

A steady stream of stories about declining bee populations has appeared in newspapers, on TV screens, and in our social-media feeds over the last couple of decades. In response, there has been an amazing groundswell of support for bees, motivating people everywhere to act—creating pollinator gardens, planting habitat in parks and on farms, reducing pesticide use or campaigning for citywide bans, holding plant sales to raise funds and increase engagement. It is clear that people care, and many have rallied around this issue.

For some, a tangible goal has been to get a honey bee hive. As a result, hives have appeared in gardens and backyards, on rooftops, and in parks and nature reserves. On the surface, this makes sense—if bees are declining, it would seem that more bees in more places will help. Yet, when we look deeper, efforts to increase the number of honey bees on the landscape may be doing more harm than good. If we want to make the most difference to help declining pollinators, where should we focus our efforts?

The honey bee that is widely found

**Getting a couple of backyard hives might seem like a good response to pollinator declines, but honey bees can be direct competitors to native bees. Photograph by Maja Dumat / Flickr.**

**Honey bees are excellent pollinators of some crops, but not all. Native species such as this mining bee are more efficient pollinators of blueberries. Photograph by Nancy Lee Adamson.**

in North America is the western or European honey bee, *Apis mellifera*. It is native to Europe, Africa, and parts of Asia, and thanks to the value of such hive products as honey and wax, has been transported to many other parts of the world, including North America. The first recorded arrivals to this continent were brought by European colonists to Jamestown (in what is now Virginia) in the 1620s; by the 1850s, honey bees had reached the West Coast. For the first three hundred years on this continent, hives were kept mostly for the honey and wax they produce. It wasn't until the early twentieth century that honey bees were widely adopted for agricultural pollination; they became increasingly important in later decades, with the advent of larger monocultures and the use of broad-spectrum insecticides.

And there is no question that honey bees are excellent pollinators of many crops. While native bees contribute significantly to crop pollination—indeed, they may be more effective pollinators of some crops (such as squash and blueberries) or even make honey bees become better pollinators (in sunflower fields, the presence of native species causes honey bees to move between rows more frequently)—honey bees are vital for crops such as almonds. To fulfill the demand for crop pollination, millions of hives are managed in and trucked all over North America, with scores of millions elsewhere in the world. Although we have seen colony losses, especially over the last fifteen years, and despite the fact that some bee keepers are struggling to maintain hives, honey bees are *not* at risk of extinction: it is estimated that there are more honey bees on the planet now than at any time in human history.

In contrast, there are more than thirty-six hundred bee species native to North America, some of which are facing a real risk of extinction. According to the International Union for Conservation of Nature's Red List of Threatened Species, 28 percent of bumble bee

**Honey bees mix pollen and nectar into a moist paste that they carry on their rear legs back to the hive. Photograph by Bryan E. Reynolds.**

species in North America are considered threatened. Further, the United Nations Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services found that more than 40 percent of invertebrate pollinator species (particularly bees and butterflies) may face extinction in the coming decades. To date, two species of bee in the continental United States and seven in Hawai'i are listed as endangered by the U. S. Fish and Wildlife Service, and several additional species await further analysis for possible protection under the Endangered Species Act.

Our native bees come in all shapes, sizes, and colors, and can be found in almost all terrestrial environments. Native bees coevolved with our native plants and often have behavioral adaptations that make them better pollinators than honey bees. For example, buzz-pollination, in which a bee grasps a flower and shakes the pollen loose, is a behavior at which bumble bees and other large-bodied native bees excel, and one that honey bees lack. So flowers that require buzz-pollination, such as shooting stars, flax lilies, and manzanita, are not served by visits by honey bees. Agricultural plants such as tomatoes, bell peppers, and blueberries also benefit from buzz-pollination, and therefore rely mostly on visits by native bees to maximize fruit production.

The way that honey bees interact with flowers means that they sometimes contribute little or nothing to pollination. One reason for this is that honey bees groom their pollen and carry it in neat pollen cakes, moistened with nectar and safely tucked into the baskets on their hind legs. By contrast, many of our native bees tend to be messier, carrying pollen as dry grains, often all over their bodies. This messiness means that the pollen they carry is more likely to contact the stigma of another flower and pollinate the plant. So, while both honey bees and native bees are good at extracting pollen, in a bee-to-bee comparison our native bees tend to be more efficient at spreading that pollen around. In addition, honey bees

are known "nectar robbers" of many plants, accessing their nectar in a way that means they don't touch the pollen, often by biting a hole in the base of the flower. An example is provided in a recently published study from researchers at the University of California, Davis, who found that when honey bees foraged on camas lilies their visits seldom resulted in pollination. The effect was compounded by the fact that the honey bees removed both nectar and pollen, which meant that there was less of them available to attract bumble bees and other native bees that are good pollinators of camas lilies.

It is, of course, true that honey bees are well-suited for large agricultural systems. Their colony sizes and ability to communicate allows them to find crop fields efficiently and to take advantage of a hyperabundant floral resource during a brief period of bloom, and in those systems their sheer numbers make up for their relative inefficiency per visit. But, when it comes to our wild and natural areas, there is no one-size-fits-all solution to pollination; a diversity of native plants requires a diversity of native bees, and vice versa. Certainly, bringing in large numbers of non-native bees is no answer to the conservation needs of these lands.

As more research is done on pollination networks, we're learning that honey bees can negatively impact our natural areas. Introducing a single honey bee hive means fifteen thousand to fifty thousand additional mouths to feed in an area that may already lack sufficient flowering resources. This increases competition with our native bees and raises the energy costs of foraging, which can be significant. Illustrating the scale of this situation, Jim Cane and Vince Tepedino of the USDA's Pollinating Insect-Biology, Management, Systematics Research unit in Logan, Utah, calculated that over a period of three months, a single hive collects as

**The majority of native bees carry pollen as dry grains packed between stiff hairs for transport. Some pollen is lost as they visit further flowers. Photograph by Bryan E. Reynolds.**

much pollen as could support the development of a hundred thousand native solitary bees. Moreover, evidence shows that honey bees can spread diseases to our native bees—deformed wing virus, for example, can be passed from honey bees to bumble bees—and can also amplify and distribute diseases within a bee community. Both competition and disease transfer are very real threats with the potential for lasting impacts on native bee species.

Concerningly, there are many existing and proposed efforts to pasture honey bees on public lands, particularly in the western United States. Native bees are better pollinators of native plant communities, meaning that the ecosystems on these public lands would not benefit from the pollination services provided by honey bees. Moreover, honey bees would compete with native bees and alter pollination networks. All of this suggests that these projects have the potential to become a tragedy of the commons, in which the ecological integrity of our natural areas are compromised in ways that benefit only honey bees. This could profoundly impact a large number of pollinating insects that need these lands to survive, places that for many species serve as their last refuge from existing threats. As many of our public lands are already degraded from a long history of overgrazing and fire suppression, we should focus our efforts on habitat restoration, not on practices that benefit honey bees at the cost of ecological integrity.

There is also an ever-expanding body of evidence demonstrating the negative impacts in towns and cities from the presence of honey bees. A recent study from Montreal, for example, showed that the number of species of native bees found in an area decreased when the number of honey bees went up. Even in Europe, where honey bees

**A single honey bee hive can include tens of thousands of individuals, which are often in direct competition with wild bees for nectar and pollen. Photograph by Susy Morris / Flickr.**

**Adding honey bee hives will not help bumble bees or the thousands of other species of bees native to North America. Photograph by Bryan E. Reynolds.**

are native, there is growing concern about the density of hives in urban areas. Researchers in Switzerland compared the known number of hives to the availability of forage plants in several cities, and concluded that there were more hives than the plants could sustain. In Britain, the London Beekeepers Association found that some parts of that city had four times as many hives as the city's gardens and parks could support. Noting that honey bees "are not in decline—not globally, nor in the United Kingdom," the Association encouraged Londoners to plant flowers and work to prevent further habitat loss. Also in Britain, the conservation organization Buglife recommends creating two hectares (five acres) of habitat for each hive, several times the size of an average residential lot in the United States.

The number of ways in which honey bees compete with or harm native bees is an excellent illustration of the complexity involved in conservation. Given the numerous other threats facing native bees—habitat loss, insecticide use, climate change, disease transmission, and more—how much should we worry about the impacts of honey bees? At the Xerces Society, we believe that our primary goal must be to reduce the threats that face all bees. It is absolutely true that honey bees don't always harm native bees: when resources are plentiful, honey bees are present at low densities, and hives are well tended, the risks are smaller. Yet, with a changing climate and a growing human population, such places are increasingly rare, and the evidence is clear that honey bees can impact native bees.

In short, beekeeping is not bee conservation. If you are thinking of getting a hive, we encourage you to consider carefully why you want to do so. Managed honey bees are domesticated livestock, and not only will their care and husbandry not help native species, their very presence has the potential to harm them. Fortunately, there are alternate actions you can take that will help both

**The best solution to bee declines is to address the underlying causes, particularly habitat loss and pesticide use. Flower-rich gardens have the ability to support all bees. Photograph by the Xerces Society / Kelly Gill.**

honey bees and the thousands of native pollinators that call North America home. The core components of bee conservation are providing food through flower-rich habitat, offering places where bees can nest and overwinter, and maintaining an environment free of pesticides and exposure to amplified or introduced pathogens. Creating pollinator habitat, or even just one component of it, has broad benefits from increasing biodiversity to combating climate change, and such habitat can be situated anywhere—in backyards, on balconies and porches, on rooftops, in office landscapes, in local parks and community gardens. Check out the "Bring Back the Pollinators" page on the Xerces website for more information.

Honey bees are fascinating to observe and manage, and can inspire people to learn more about insects. But a preferable approach to bee conservation is to focus on habitat. We all long to see our backyards and gardens full of buzzing bees: know that if you build good habitat, they will come!

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*Rich Hatfield is a senior endangered species conservation biologist. He leads the Xerces Society's efforts to protect bumble bees, including overseeing the regional bumble bee atlas projects that now cover 40 percent of the lower forty-eight states.*

*Matthew Shepherd is director of outreach and education. He works with local communities to promote pollinator conservation, including the Bee City USA and Bee Campus USA affiliates.*

# Strengthening Communities Through Urban Agriculture

*Stefanie Steele*

A common experience that many of us share is growing our own food. Perhaps your connection lies with your own personal involvement, or from the stories your family told, which may stretch across generations; or maybe your participation was from an experiment as simple as growing a bean plant with your class in school. For me, my story began with learning about my family's history. Both of my parents and their extended families were some combination of gardeners, farmers, or landscapers. They relied on the fruits and vegetables they grew at their homes to nourish their growing families.

Some of my most distinct memories from my childhood in Cincinnati, Ohio, are of the fruit trees and vegetable garden in our backyard. Two cherry trees and a plum tree lined the path to my family's two-hundred-square-foot vegetable garden behind the garage. In that small space, we grew tomatoes, peppers, squash, cucumbers, chard, and other vegetables to supplement the food we bought from grocery stores, and to take an active role in how we fed ourselves. Looking back, what really stays in my mind is a bit contradictory. I remember, as an elementary-aged child, spending significant time weed-

**A small carpenter bee working on her nest in a pithy stem. These bees can adapt to disturbed environments and may frequent urban sites. Photograph by Sara Morris.**

ing around the vegetables, and, if I am honest, these experiences were not always pleasant. I would get poked by the spines of the squash plants, become covered in the sticky fragrant oils from the tomato vines, and occasionally step on a squishy fallen tomato. On the other hand, I enjoyed climbing a ladder up into the branches of a cherry tree and picking the ripe red fruit within reach before the birds ate it.

Even though as a young person gardening was not always a joyous activity, exploring the larger natural world was. I was privileged to grow up within walking distance of Cincinnati's Mt. Airy Forest, a rich urban system of forest and creeks, where I would search for fossils and crawdads, and learn about the birds, plants, and other wildlife there. Roaming these woods allowed me to discover my sense of adventure, practice thoughtful observation, and develop a deep appreciation of the beauty and wonder to be found in nature, which helped spark my love of pollinators.

My younger self would be proud to learn that I continued to pursue my passions and in that pursuit moved across the country to Oregon to begin a new adventure at Portland State University, where I studied the urban bees of Portland and their natural history. My own research at PSU, as well as other studies published in recent years, shows that urban areas can support a diversity of pollinators and other beneficial insects. With floral food resources, shelter for nesting, and refuge from pesticides, urban agriculture sites in particular offer a great opportunity for pollinator habitat and community engagement.

**Adventures in Cincinnati's Mt. Airy Forest when growing up helped the author develop a connection to and appreciation of the natural world. Photograph by Stefanie Steele.**

**The Michigan Urban Farming Initiative uses sustainable agriculture to help build community and address social justice issues in Detroit. Photograph by the Xerces Society / Stefanie Steele.**

Inspired by what I had been researching, I created my own mini-oasis for bees at my rented house. I distinctly remember the immediate presence of small carpenter bees on the *Agastache* and small sweat bees on the *Coreopsis*. When my chives bloomed, it was a treat to see all of the little bee behinds sticking out of the globe-shaped purple flower heads. Toward the beginning of my second gardening season, I even saw a Vosnesenksy's bumble bee queen searching for a nest. My garden brought me so much joy and a great sense of purpose. Though small, it not only offered sustenance for local wildlife, but also—thanks to consistently yielding produce for myself and my friends—contributed to my food security while I navigated my financially thin undergrad years.

The benefits that I gained from that small backyard, such as access to fresh food, mind and body wellness, and habitat for pollinators, are similar to what generations of my family experienced with their farms and gardens. They are part of what I carry with me now in my roles as a pollinator conservation specialist with the Xerces Society and as a partner biologist with the Natural Resources Conservation Service, working with small-scale and historically underserved urban agricultural producers in Detroit, Michigan.

New to the city, I am still learning about its difficult past and the way that history has necessitated revitalizing the urban landscape. By the early 1950s, at its peak as the leader of the automotive industry, the city of Detroit had a popu-

**Xerces is supporting urban farmers such as the Detroit Partnership for Food Learning and Innovation in undertaking small-scale habitat-improvement projects. Photograph by the Xerces Society / Stefanie Steele.**

lation of 1.85 million people. In the following decades, however, the industry restructured and dispersed out of the city for reasons that included technological advances as well as resistance to labor unions and the rising costs of wages. During this period there was also massive movement, primarily of white residents—what came to be known as "white flight"—to suburbs in the surrounding metropolitan area, where discriminatory redlining practices were common. After the automobile factories closed, no other major industries replaced them, leaving many (primarily Black) residents in poverty, and a great number of the city's buildings empty. As time went on, financial crises, discrimination, and civil unrest continued to impact the city.

The population of Detroit has decreased by more than a million people in the decades since its peak, leaving between 24 and 40 percent of both land and structures vacant, as reported by the *Detroit Free Press* in 2019. This shift in city dynamics has resulted in areas of "food apartheid." This term, coined by community food activist Karen Washington, addresses the human right of access to fresh affordable food and the social inequities around such access, particularly in low-income neighborhoods and communities of color.

Similarly, a lack of green spaces, including parks and tree-lined streets, has also disproportionately affected these communities, contributing to threatening environmental changes such as higher temperatures, increased flooding, and worsened pollution. Further exacerbating the shortage of tree cover, the

emerald ash borer, a non-native beetle, arrived in the area in 2002, devastating the local ash trees. Despite the apparent magnitude of these long-term challenges, the city's vacant lands hold great potential, and urban agriculture can offer some solutions in the form of ecological restoration and habitat creation.

When working with communities of color who have historically been excluded and underserved, it is important that their members participate in—and are indeed leaders in—the conversations that give impetus to and shape the projects that would serve them. Knowing the history of a community is critical to understanding the ways that land was used and the objectives for urban revitalization. Community-oriented urban agriculture initiatives can offer excellent opportunities for residents to learn more about our food systems and the nature around us, including the diverse world of insects and other invertebrates. The main factors driving urban agriculture include food security and sovereignty, community development, blight-to-beautification efforts, and reduction in violent crime. Adding native plants to support habitat for pollinators and other species can also help to reduce the effects of urban heat islands and to increase wildlife habitat corridors.

The landscapes themselves, though, can create barriers to both urban farming and habitat restoration. Heavy metals and other soil contaminants, debris, and noxious plant species pose dangerous, time-consuming, and often expensive barriers to projects in urban areas. It is important to be familiar with local ordinances, as they might have regulations on permitted plant species, heights, or maintenance. Plant selection and sourcing for habitats must be considered, to ensure that plant materials are regionally appropriate and free of pesticides. It is helpful to keep in mind that some native plants are "advantageous spreaders," and may easily dominate smaller-scale habitats, although these species could also provide a good option for urban gardeners to share with friends and neighbors.

From the perspective of invertebrate conservation, urban agriculture can be a great way to improve biodiversity through the ecological restoration of habitats for pollinators, beneficial insects (predators and parasitoids), and soil invertebrates. Approximately three-quarters of world crop species, many of which produce vital micronutrients, rely on or benefit from pollinators. These include crops such as tomatoes, peppers, squash, strawberries, raspberries, apples, pears, and cherries. By necessity urban farmers work very efficiently, growing a diversity of crops across the seasons in order to maximize the utility of their small spaces and regenerate the soils. This diversity in crop production can directly influence the diversity of insects that are present, and improve soil health and invertebrate life. Increased populations of beneficial insects are an important gain as these species can be natural enemies of common crop pests, thus reducing reliance on harmful pesticides. Referred to as conservation biological control or CBC, this natural pest-management strategy is something that Detroit's urban growers are interested in, and that I am excited to incorporate into my work.

This past summer I was able to visit several farms, during which I learned more about their diverse crop systems

and culturally significant plants, took note of the pollinators, assessed existing habitat, and discussed plans for expanding it. One of my first visits last June was to D-Town Farm, located near Rouge Park, in northwest Detroit. While there, I was delighted to share with the farmers information about some of their native bees. We observed new bumble bee queens, small carpenter bees emerging from pithy bramble stems, and mining bees sunning themselves on nearby raspberry leaves. At the end of July, during a late-morning visit to another farm in the city's northwest, Detroit Partnership for Food Learning and Innovation, we watched numerous squash bees and two-spotted long-horned bees visiting summer squash flowers, as well as leafcutter bees, bumble bees, and sweat bees foraging on mountain mint, beebalm, black-eyed Susan, and foxglove beardtongue that were all blooming in a pollinator planting near the crop field. Also present were small metallic green sweat bees nesting in the decaying logs used as a border around the habitat. Such diversity in a small area!

At both of these farms, we began conversations about how to expand their habitat for pollinators and beneficial insects, as well as ways to address other needs that they identified. D-Town Farm was a wetter site, with a pond in which the farmers collected rainwater to irrigate their crops. Late-summer mosquitoes always hit this farm hard, and one goal they had was to create habitat that dragonflies could use. We did not add aquatic plant species to their pond at this time, but instead planted tall native wildflowers

**This pondside pollinator habitat at D-Town Farm provides a place where mosquito-eating dragonflies can perch. Photograph by the Xerces Society / Stefanie Steele.**

**Squash bees, a ground-nesting solitary species, forage only on the flowers of squash and related species. Photograph by Jim Cane / USDA-ARS.**

that dragonflies could perch on while hunting, including cup plant, prairie dock, and Joe Pye weed. Signs to mark pollinator habitat and help with plant identification were also provided to the farms, so that the plantings could serve as educational demonstration gardens for the local communities. Neither farm uses any pesticides or herbicides, so planting native plants to support CBC practices was important to them as well.

I look forward to continuing to learn from and work with the unique and vibrant communities in Detroit and southeastern Michigan. There are several new and growing efforts—Xerces' Detroit Pollinator Habitat Kit program, which provides free plants; ongoing work with the USDA People's Garden Initiative; and expanding the NRCS's pollinator habitat programs to urban farms—that will help more residents to experience a greater diversity of pollinators and other wildlife close to home.

The opportunities that I was privileged to have while growing up influenced my path in life and opened doors that allowed me to be where I am today. Black and Brown entomologists and farmers are few and far between in a white-dominated society, so I am very excited to be able to work in such a diverse city and to share my passion for pollinators with growers who look similar to me. Detroit has experienced many hardships in its history, but residents remain resilient and continue to create unique opportunities from the adversities that they've faced. Formerly vacant lots are being reclaimed by community members and restored for urban agriculture, creating places where generations of people can come together to learn, grow, and share with each other. I am glad to be a part of these efforts.

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*Stefanie Steele is Xerces' pollinator conservation specialist for urban and small farms in underserved communities and an NRCS partner biologist. Based in Detroit, Michigan, she focuses on incorporating pollinator and other beneficial invertebrate habitat in small urban agricultural areas and community gardens in historically excluded communities.*

# STAFF PROFILE

## Stefanie Steele, Pollinator Conservation Specialist

*How did you hear of the Xerces Society?* During my sophomore year at Portland State University I took a course in environmental issues and action. For my class project, I chose to address pollinator conservation and declining pollinator habitat in urban areas by starting a faculty-supported, student-led bee task force. The bee task force helped PSU become one of the first Bee Campus USA affiliates; we used the Xerces website in our research, and explored its resources to help with our habitat plans.

*What made you want to work at Xerces?* I have a very specific niche interest and background of studying the natural history of our urban solitary bees, but did not want to stay in academia. Living in Portland, Xerces' hometown, brought the opportunity to meet a few staff and attend their events. When I saw the posting for this position—"Pollinator Conservation Specialist for Urban and Small Farms in Underserved Communities"—I knew that it was what I wanted, and loved that I would be able to create tangible change for pollinators. I also really appreciated the intentional work with diverse communities that this position offered, especially being a woman of color. Diversity and representation are so important, and I am happy that my work is not only prioritizing BIPOC communities who historically have often been underserved and excluded in conservation work, but that I can serve as an example of what a scientist and nature educator can look like.

*What do you do to relax?* I enjoy spending time outside, whether taking a walk in the neighborhood, exploring a favorite park, or finding a new natural space—and if these areas are near bodies of water, even better! I also take pleasure in discovering Detroit, as well as spending time at home curled up with a blanket and a nice beverage, watching a show, or catching up with friends and family.

*What music do you enjoy?* I listen to a wide variety of music, which tends to change with the seasons, my mood, or the task at hand. A couple of favorite genres that I'm currently listening to are neo-soul and jazz, with artists like Esperanza Spalding, Jamila Woods, Madison McFerrin, and Hugh Masekela. Since moving to Detroit, I have enjoyed being introduced to new genres and artists, such as the city's famous house music.

# PARTNER SPOTLIGHT

## Collaborators on Firefly Conservation

This spotlight features several partners who play important roles in our rapidly expanding effort to protect fireflies. We could not have mentioned one and ignored the others!

Sara Lewis, professor emerita at Tufts University in Medford, Massachusetts, is an acknowledged expert on fireflies and a leading voice for their conservation. Sara was a co-author of the Xerces Society's 2019 report *Conserving the Jewels of the Night*, and has since collaborated with Xerces staff on *State of the Fireflies* and other reports, as well as on peer-reviewed journal papers. In addition, Sara is involved with two of our other featured partners: she co-chairs the Firefly Specialist Group of the International Union for Conservation of Nature, and is a founder of Fireflyers International Network.

We also recognize the work of Anna Walker, species survival officer for invertebrate pollinators at the New Mexico BioPark Society. Anna has been a partner on several projects assessing the status of fireflies, and is a co-author on peer-reviewed journal papers and the *State of the Fireflies* report. Like Sara, she is a member of the IUCN Firefly Specialist Group, and played a key role in completing IUCN Red List assessments.

Both the IUCN Firefly Specialist Group and the New Mexico BioPark Society are partners in the newly launched Firefly Atlas, a community science project managed by Xerces to gather information about fireflies in the United States and Canada. The Firefly Specialist Group draws together researchers and conservationists from across the globe to gather data and identify those species at greatest risk. The BioPark Society is based in Albuquerque, where it supports the city's BioPark zoo, botanic garden, and aquarium, and hosts the Center for Species Survival New Mexico.

Last, though definitely not least, members of the Fireflyers International Network assist Xerces with gathering information and expanding connections with scientists and conservationists. Many of our firefly materials are graced by remarkable photographs taken by FIN member Radim Schreiber, who generously allows us to use his images.

**Photograph by Radim Schreiber.**

## Putting Fireflies on the Map

The Xerces Society, in collaboration with the New Mexico BioPark Society and the IUCN Firefly Specialist Group, has launched the Firefly Atlas, the first resource to serve as both an educational hub for firefly conservation and a portal for data collection from across the United States and Canada. To better understand and protect the more than 170 species of North American fireflies, we need to know where they are found. The atlas enables participants from all backgrounds—community scientists, gardeners, nature enthusiasts, researchers, conservation professionals—to contribute observations of species from all three groups: the classic flashing fireflies, as well as the less well-known glowworms (whose flightless females glow) and day-active fireflies (which light up as larvae but not as adults). These sightings will be used to inform conservation efforts.

**Got fireflies? Snap a photograph and submit it to our new Firefly Atlas. Photograph by the Xerces Society / Katie Lamke.**

This broad-based mapping is combined with a narrower focus on gathering information on threatened and data-deficient species in particular regions: the Mid-Atlantic, the Southeast (including Florida and extending northward into the Midwest), and the Southwest. In these regions, targeted surveys will gather information about thirteen species that are of conservation concern and can be reliably documented and identified with a combination of photographs and flash-pattern observations. You can sign up to contribute to either the general survey or one of the regional efforts at fireflyatlas.org.

Xerces staff already are taking steps to protect the most vulnerable fireflies in North America. We previously petitioned the U.S. Fish and Wildlife Service to protect the Bethany Beach firefly (*Photuris bethaniensis*) under the Endangered Species Act, and have recently submitted petitions for four additional species that are on the brink. These are the mysterious lantern firefly (*Photuris mysticalampas*), found on the Delmarva Peninsula of Delaware and Maryland; the loopy five firefly (*Photuris forresti*), known from ten wetlands in Tennessee, South Carolina, and Georgia; the Florida intertidal firefly (*Micronaspis floridana*), occurring only in the mangroves and salt marshes of coastal Florida and the Bahamas; and the Southwest spring firefly (*Bicellonycha wickershamorum*), which is limited to southern Arizona and Sonora, Mexico.

**A new study identifies the best way to create connected habitat across farmland in California's Central Valley. Photograph by the Xerces Society / Jessa Kay Cruz.**

## Connecting Habitat in the Central Valley to Help Pollinators

California's Central Valley was once dominated by native grasslands, wetlands, and river and floodplain habitat. Most of these natural environments have been lost to development or agriculture, and although many farms retain some habitat, it tends to be isolated and impacted by pesticides. Finding ways to connect these remaining patches enables wildlife to migrate across landscapes in search of new habitats and refuge from a changing climate. Such movement between patches can increase genetic diversity and build resilience within pollinator populations.

Scientists from the Xerces Society joined with researchers at the University of Nevada at Reno to develop a tool for modeling landscape connectivity for insects. The model combines land-use information, knowledge about the lethality of pesticides, and expert opinion to identify the opportunities to create habitat and provide habitat connectivity that will bring the greatest benefits to insects.

The study was published in the journal *PLOS One* in February. It is unique in that it considers pesticide use as a limitation on habitat value, providing a real-world assessment of the potential for agricultural field margins to enhance habitat connectivity for pollinating insects. Modelling showed that, by adding hedgerows and native flower strips along drainage ditches, field edges, and uncultivated borders, and by protecting those areas from pesticide use, more than a million acres of habitat could be added to the Central Valley, improving pollinator survival and protecting our future crops and food supply.

## Another Mixed Year for Overwintering Monarchs

The overwintering aggregations of monarch butterflies provide an opportunity to estimate the sizes of their populations. The number of monarchs along the California coast is assessed by the Xerces Western Monarch Count, coordinated by Xerces staff and volunteers; and the colonies in central Mexico are measured by the World Wildlife Fund.

This year, California, with more than 335,000 butterflies, had its largest overwintering population in two decades. This was up significantly from last year and was an encouraging rebound from two years ago, when only a couple thousand monarchs were tallied. Excitement was quickly tempered, though, by back-to-back storms that battered California and caused flooding, downed tree limbs, and even uprooted entire trees in some overwintering sites. The loss of monarchs due to the storms means that we may start the spring with far fewer than were counted.

The news from Mexico was disappointing, with just five and a half acres of forest occupied by monarchs, a drop of 22 percent from the previous winter. In addition, the World Wildlife Fund reported that 145 acres of forest in the Biosphere Reserve have been degraded by logging, fires, and drought.

Xerces continues to work to secure a future for the monarch and its habitats. While migratory monarch butterflies were declared endangered on the IUCN Red List last summer, this status does not confer protection. The Xerces Society and partners asked for protection for the monarch in 2014 and the U.S. Fish and Wildlife Service should decide by the end of next year whether monarchs will be listed under the U.S. Endangered Species Act. The best hope for this butterfly is to restore breeding habitat throughout its range, and to ensure that overwintering sites are protected and resilient to climate change.

**More monarchs overwintered in California than at any time in the last twenty years. Photograph by the Xerces Society / Isis Howard.**


**River City Garden, New York. Photograph by Anna Victoria.**

## Help Spread the Word

After making room in your community for the creatures you adore, you can celebrate your hard work by displaying a Xerces Society habitat sign in your yard, farm, or neighborhood. Produced specially for all of you—our biggest supporters—these beautiful and durable 9" x 10" outdoor yard signs can easily be mounted to a fence or post, and are sure to catch the eye of all passersby.

You can find your yard sign, along with *100 Plants to Feed the Bees* and other Xerces Society books, at **xerces.org/gifts**.

## Colorado Launches Statewide Study of Native Pollinators

The Xerces Society is collaborating with the University of Colorado Museum of Natural History and Colorado State University Extension on a statewide study of native pollinators. "This new study is a step our community is taking to strengthen Colorado's pollinator ecosystems, ensure they are in a position to thrive, and help the rest of our natural world," said Governor Jared Polis.

The Colorado Legislature appropriated funding for the Colorado Department of Natural Resources to commission the partners to report on the challenges facing native pollinators and their habitats, and to recommend management practices and policies to address the health and resilience of pollinator populations. In announcing the study, the department noted the importance of pollinators to food systems and overall biodiversity, and to ecosystem services such as climate regulation, erosion control, and nutrient cycling.

Xerces and the other partners will consult with state and federal agencies, researchers, scientists, and land managers across the state, to provide the most comprehensive review of Colorado's pollinators carried out to date.

# REMEMBRANCES

In the last few months the Xerces Society and the wider butterfly conservation community have lost several long-time friends and collaborators. The following notes and recollections illustrate their influence.

## Paul Opler (August 3, 1938–February 6, 2023)

Paul Opler was an internationally acknowledged expert on Lepidoptera, whose involvement with butterfly conservation was both professional and personal. In 1974 he was hired as the first entomologist in the U.S. Fish and Wildlife Service's newly created Office of Endangered Species, where his work led to the protection of several butterflies. Paul was also active in the Xerces Society. He served on Xerces' board of directors from 1979 to 1998 and was vice president of the board from 1982 to 1998.

Paul authored several books on butterflies, including two Peterson guides—*A Field Guide to Eastern Butterflies* and *A Field Guide to Western Butterflies*—which made him a household name for many people.

Scott Black, Xerces' executive director, remembers Paul as being "the first person I encountered who combined a deep knowledge about insects with a passion for their conservation. When we first met, in the 1990s, I remember talking with Paul about how we might protect habitat for the Uncompahgre fritillary butterfly, and issues surrounding climate change—the first time I had discussed butterflies and climate change with anyone. My last conversation with Paul was just a few weeks ago. He will be greatly missed by the conservation community."

## Sarah Anne Hughes (August 9, 1951–March 7, 2023)

Sarah Anne "Sally" Hughes didn't have an entomology background, but had a major influence on the success of the Xerces Society in its early years. Sally was a talented artist who drew the Xerces blue butterfly that formed our first logo, and whose illustrations adorned Xerces' early journal, *Atala*, as well as many reports and other publications. She also launched the Fourth of July Butterfly Count, which the society ran from 1973 to 1993.

Sally first studied botany, then took her PhD in museum studies, and ended

her career on the faculty at Oxford Brookes University in Britain. In retirement, she enjoyed butterfly conservation work (hunting brown hairstreak eggs and helping with habitat management work parties) and photography.

Xerces founder Robert Michael Pyle noted Sally's "big role as a Xerces pioneer: helping in so many ways during the early going in the United Kingdom and at Yale, and starting the Fourth of July Butterfly Counts. She also contributed the wonderful artwork for the Invertebrate Red Data Book and for many *Atala* covers, Xerces cards, and the Peterson coloring books."

## Dan Meade (February 1, 1954–November 26, 2022)

Xerces staff and many in the western monarch community were shocked last November by the unexpected death of Dan Meade, a monarch overwintering expert, consultant, and advocate. Some of his many contributions include writing overwintering management plans for key sites in central and southern California, completing comprehensive surveys of more than a hundred overwintering sites in Santa Barbara County in 1998 and again in 2017, attending the recent Monarch Butterfly Conservation Summit in Washington, D.C., and being a longtime contributor to the Western Monarch Count.

Xerces endangered species biologist Emma Pelton remembers Dan as "a very kind and humble person who worked for decades on western monarch conservation, including the protection and management of overwintering sites."



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**Visit us at xerces.org or contact us at 855-232-6639.**

**A lyric cicada emerges from its nymphal case. Its bright colors will fade as its exoskeleton hardens. Photograph by Bryan E. Reynolds.**

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**On the cover: With their wings closed, underwing moths such as this one can blend with bark or other backgrounds, but when disturbed, they flash brightly colored hind wings to startle the intruder. Photograph by Bryan E. Reynolds.**

XERCES SOCIETY
for Invertebrate Conservation