

WINGS

ESSAYS ON INVERTEBRATE CONSERVATION



THE XERCES SOCIETY

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A Holistic Approach to Invertebrate Conservation

Scott Black

The Xerces Society is making headway toward a healthier, more livable future. We work with people from diverse backgrounds to support the bees, butterflies, and other invertebrates—and their habitats—that are critical to the stability of our food webs and ecosystems.

Xerces' unique, holistic approach encompasses on-the-ground conservation work, outreach to communities, and advocacy for policy change, all driven and informed by research—and focused on helping to solve the dual crises of climate change and biodiversity loss.

On-the-ground conservation. We improve habitat in towns and cities with partners through our pollinator habitat kits and by supporting communities and organizations nationwide. We work with federal and state land-

management agencies to care for rare and declining invertebrates on public lands. We help agricultural professionals adopt beneficial farming practices through our USDA partner biologist program. And our Bee Better Certified® program, the first third-party-verified pollinator-conservation certification, is driving tremendous shifts in the supply chains of some of the largest food companies in the world to support healthy pollinator populations.

Outreach and education. We raise awareness of and appreciation for invertebrates, and provide the information people need to take conservation action through publications, X Kids, the Bee City USA and Bee Campus USA programs, and our Xerces Ambassador volunteers. So far this year, 146 Ambassadors



In the last few years, Xerces' habitat kit program has provided hundreds of thousands of regionally appropriate native plants to hundreds of communities. Photograph by the Xerces Society / Jessa Kay Cruz.

participated in more than 470 events in thirty-eight states. Through these and other events involving Xerces staff, we connect directly with tens of thousands of people each year, and reach millions more through media coverage and our digital communication channels. This work is helping people adopt the actionable solutions we provide, from changing pesticide practices and planting habitat to speaking out in their community.

Advocacy and policy. We gain protection for vulnerable species at state and federal levels, leading to changes in land and water management that benefit not only rare and declining invertebrates, but entire wildlife communities. We promote local, state, and federal policies to minimize pesticide impacts, and advocate for states to increase funding and authority for invertebrate conservation. Xerces research and expertise help to design policy solutions that address the causes of invertebrate declines.

Applied research and community science. We collaborate with scientists, agencies, and universities to understand invertebrates and the threats that impact them. We have published peer-reviewed papers, fact sheets, reports, and other resources that are helping guide invertebrate conservation across the country. We also harness the power of crowd-sourced data and public participation with more than twenty-six thousand community scientists, which enables us to collect data on insects at a very large scale. This research helps us to better understand what is driving insect declines, identify the habitat needs of imperiled species, and design effective solutions for recovery.

During my tenure, Xerces has grown from a handful of staff to more

than a hundred, all of them striving to deliver much-needed change. We work to shape and protect millions of acres of climate-resilient and biodiverse lands and have made notable strides in securing a diverse range of pesticide policy changes. We combine the knowledge of expert scientists, the resources and capacity of government agencies, and the passion and enthusiasm of communities to make tangible and meaningful conservation gains.

In the past year alone, our collaborative efforts have yielded amazing progress and noteworthy accomplishments:

- ◆ More than eight million acres of public grasslands were protected from large-scale insecticide applications.
- ◆ More than a hundred thousand acres of habitat were created through our partnership with the USDA.
- ◆ A total of 457 community partners received more than 110,000 native plants through our habitat kit program.
- ◆ Some 19,760 acres of farmland were able to achieve Bee Better Certification®.
- ◆ We reached more than seventy-six thousand people through almost seven hundred events, workshops, lectures, and webinars.
- ◆ Fifty-one communities joined the Bee City USA and Bee Campus USA network, expanding it to more than four hundred affiliates.

Day in and day out, we continue to grow a movement of people who recognize the interdependence between humans, invertebrates, and the well-being of our planet. Thank you for your ongoing support and engagement in this critical work.

The Hedgelands

Eric Lee-Mäder

The writer George Bernard Shaw is often credited with noting that England and America are two countries separated by the same language. Words common to both nations sometimes refer to totally different things; “football” is an obvious example. More often, however, the meanings are similar but the precise connotations are different—like “pants” and “trolleys.”

“Hedge” is another word that has different connotations. In Britain (and in broader Europe) a hedge is possibly a wild rural affair, perhaps a massive, centuries-old living fence of interwoven native trees and shrubs that might enclose

livestock and delineate regional boundaries. Meanwhile, in America, a hedge today is more likely to be a group of low boxwoods trimmed neatly into right angles in front of a suburban home, or a row of arborvitae planted to provide privacy between neighbors.

Yet a more precise term for any dense linear plantings of trees and shrubs is “hedgerow,” from Old High German *hegge* or *hegga* (meaning a grove of trees or bushes) and Old English *reue* or *ræw* (a straight-line configuration of objects). These are recorded in a written trail for the presence of hedgerows as a valuable asset that can be followed back



A country track in Oxfordshire, England. Mature hedgerows such as these, with a diversity of shrub and wildflower species, provide important habitat for butterflies, bees, and much more. Photograph by Dave_S / CC BY 2.0.

through the Domesday Book of 1086 to Anglo-Saxon records of property ownership in Britain from as early as the seventh century. The story of hedgerows themselves, however, goes much further back and is, in part, a story of early agrarian settlement. The more wild forms of hedgerows may offer a model for how we can reintegrate nature into our most heavily human-altered spaces.

As an identifiable landscape feature, hedgerows can be traced back roughly four millennia to early Bronze Age Europe, when nomadic hunters—perhaps in response to resource depletion—settled into farming. In places like ancient Ireland or Normandy this probably necessitated clearing patches of the vast forest to create sunny openings where primitive grain crops could be grown. As other nearby farmers slashed and

burned their own clearings, the forest eventually receded into thin strips of remaining trees and shrubs separating one farmer's field from that of another. Over centuries, large primeval woodlands shrank to become thin relic skeletal segments. Hence the first, and oldest, hedgerows.

Despite their diminished size, these linear forest strips retained value as a renewable source of wild food plants and wood for construction and fuel, as well as a haven for game. Branches from hedges of hawthorn and blackthorn—both bearing sharp spurs—could be woven together into fences to contain livestock and ward off invaders. In fact, Roman emperor Julius Caesar wrote of western Europe's hedgerows in his accounting of the Gallic wars (58 to 50 BCE), describing well-maintained bar-



The *bocage* landscapes of Normandy and other areas of France support a network of centuries-old hedgerows. Careful management has maintained their longevity. Photograph by Yves Jalabert / CC BY-SA 2.0.



A freshly laid hedge in southern England. Partially cut stems bent along the hedge (held in place by a “rope” of hazel) will regrow, creating a dense barrier. Photograph by Naturenet / CC BY-SA 4.0.

ricades of living trees and woven brambles that hindered his military advances. From both Caesar’s accounts and some more-recent discoveries, we know that some of western Europe’s intact hedgerows are extremely old. One notable sleuth was English naturalist Max Hooper, a master of forensic botany and researcher at Monks Wood, a nature reserve in the east of England (where, coincidentally, Xerxes’ founder Robert Michael Pyle was based in the early 1970s).

In the course of his research, Hooper began to notice a correlation between the age of ancient farmland hedgerows and their plant diversity. Digging deeper, he examined nearly three hundred hedges of known ages (between seventy-five and eleven hundred years old), and found a general pattern: on average, Britain’s hedgerows have one additional species of tree or shrub for every century of their age. An older hedgerow is thus more likely to have some original forest species, such as oak, ash, hazel, or spindle.

Using a formula that came to be known as Hooper’s Rule, a person can walk a hundred-foot length of hedgerow, counting the number of woody plant species. When that total is multiplied by one hundred, the approximate age of a hedge is revealed. The precision of Hooper’s Rule has been debated since it was first published in 1970, but there is general consensus among ecologists that older hedges typically do have more plant species—and, where Hooper’s Rule has been compared against ancient maps, there is strong evidence that some extant hedges in Britain may predate Christianity. Some may have even existed when Stonehenge was built.

As farming became the dominant use of land in Europe, hedgerow management became more intentional. Professional hedgers could be employed to plant new hedges or to fill in gaps within existing ones. Shoddy hedges could be renovated through hedgelaying—partially cutting through the vertical trunks of small trees and bending them



Osage orange was the tree of choice for planting hedgerows across much of the United States. Now largely abandoned, the hedges continue to be distinctive landscape features. Photograph by Jim Griffin / CC0 1.0.

so that they lie along the length of the hedge. This created a stock-proof barrier and encouraged a dense proliferation of new shoots. And, like so many other European lifeways, the concept of hedgerows arrived with European settlers in the New World, the most notable example being the development of Osage orange hedgerows.

Initially found only in what are now the states of Arkansas, Louisiana, Oklahoma, and Texas, the Osage orange was quickly recognized by newly arriving prairie farmers as a reliable tree that could be planted in closely spaced rows and aggressively pruned into thorny walls for containing livestock. From its large, strange, hard fruit, the tree produces abundant, easy-to-grow seeds. And, once growing, single trunks can be cut back to the ground to produce a riot of new bushy stems.

The Osage orange also turned out

to be highly adaptable far beyond its original range, eventually leading to its planting in more than thirty other states. Why this hardy tree was not originally more widespread remains something of a mystery. One theory is that Osage orange seeds might have been previously dispersed by Pleistocene-era megafauna such as giant sloths; with the extinction of those large mammals, perhaps the tree's opportunities to spread were reduced. Whatever the actual case may have been, the planting of Osage orange hedgerows eventually ceased in the 1870s, with the invention of barbed wire—and, in a strange irony, many Osage orange trees were later harvested and milled into fence posts.

Hedgerows have experienced profoundly changing fortunes since the introduction of wire fencing. At first glance, the costs and efforts of maintaining a robust hedgerow are enormous

compared to fences, and, of course, it can take years to grow a livestock-proof hedge. While these factors contributed to the neglect and decline of hedgerows, the advent of tractors and the ability to cultivate larger expanses made them an impediment to the scaling up of agriculture in the early twentieth century. In both the United States and Europe, farmers began to grub out hedges to create larger, more profitable fields.

The disappearance of hedgerows and other natural field edges, though, soon created new challenges. In the U.S. Great Plains, ever-increasing field sizes combined with unmitigated wind and drought to accelerate soil erosion, producing the Great Dust Bowl, which lasted from 1934 to 1938. Paradoxically, some of the most heavily affected counties in Texas and Oklahoma had been home to some of the original plantings of Osage orange.

In response to the Dust Bowl, the administration of President Franklin Roosevelt launched the Prairie States Forestry Project, with the goal of planting linear windbreaks of trees and shrubs along a hundred-mile-wide band extending from North Dakota to Texas. Farmers and laborers with the Works Progress Administration were paid to plant these windbreaks (also known as shelterbelts) along fence lines surrounding farm fields. Various native trees and shrubs such as Osage orange, red cedar, ash, boxelder, willow, buffaloberry, and chokecherry were employed, as well as tough trees and shrubs imported from the Eurasian steppe. The Great Plains Shelterbelt, as the planting region was sometimes called, encompassed nearly twenty thousand linear miles of plantings, consisting of some 220 million

trees and shrubs. At least in some places, hedgerows were back.

The Great Plains Shelterbelt was established with the goal of reducing wind velocity and mitigating moisture evaporation from the soil. Farmers also noted the benefit of windbreaks in capturing drifting snow, resulting in more meltwater to recharge moisture in adjacent fields. These benefits have been well studied and documented. For example, soil scientists have determined that linear tree and shrub plantings can slow ground-level wind speed over an area to a height of at least three to five times that of the vegetation.

More recently, there has been an even broader focus on the conservation value of hedgerows, specifically the fostering of biodiversity. In Europe there has long been a recognition of hedgerow-associated wildlife—particularly mammals such as hedgehogs, foxes, badgers, dormice, and stoats, but also butterflies and various songbirds. Ornithologists in the United States have known for decades that some bird species—notably brown thrashers, cardinals, mockingbirds, hummingbirds, quail, pheasants, and loggerhead shrikes—use hedgerows and overgrown fence lines extensively as their preferred habitat. Until recently, though, few people had focused on the invertebrates that might be associated with hedgerows. This changed when pollinator declines were cast into the spotlight in the early 2000s, prompting researchers and conservationists to consider whether hedgerows might be useful for sustaining wild bees within agricultural areas.

The majority of U.S. research into the relationship between pollinators and hedgerows emerged in California's

Central Valley, one of the most intensively farmed areas of North America. This is a region with many pollinator-dependent crops, but that now has scant natural habitat. Through the pioneering work of Yolo County farmer John Anderson, University of California Extension agent Rachel Long, and others, a few conservation-minded folks had already been experimenting with local hedgerow planting for more than a decade. These sites, with their drought-tolerant, native flowering trees and shrubs, provided an important foundation for new research into pollinator conservation.

Today, through the work of scientists from various universities across California and beyond, we now have a crystal-clear picture of the conservation value of hedgerows for wild bees—and that value is enormous. Fundamentally, hedgerows sustain wild bee populations by providing nesting structure,



Many native bees, including mining bees, feed and nest along hedgerows. Photograph by Bryan E. Reynolds.

as well as diverse food sources of pollen and nectar. Additionally, hedgerows offer connectivity for wild bees to move across vast landscapes, relatively more protected from danger than in exposed crop fields. Moreover, through the research conducted by former University of California scientists Claire Kremen, Lora Morandin, and others, we also know that hedgerows effectively “export” bees into adjacent crops where, in some cases, they may be able to provide all of the pollination necessary for crop production.

As an outgrowth of that initial research focused on pollinators, scientists have also gradually homed in on the possible pest-management value of hedgerows on farms, and those findings are equally compelling. For example, one landmark study compared how many pest-insect eggs were attacked by beneficial predatory insects on farms. When comparing farms with hedgerows versus farms without hedgerows, not only were significantly more pest eggs attacked on the farms with hedgerows, but the egg predation was more widespread across fields. It turns out that hedgerows support both pollinators and the predators of crop pests.

This contemporary hedgerow science has been of enormous value to the work of Xerces, state and federal conservation agencies, and farmers. Given this multifaceted conservation value, more than two hundred miles of hedgerows have been established in California alone since the beginning of this century, and many conservation hedgerows are actively being installed elsewhere, from coastal Maine to the windswept northern plains of Montana—with results immediately obvious to anyone



Combining insectary strip, beetle bank, and foraging, nesting, and overwintering sites into one neat package, hedgerows are a wonderful way to enrich any landscape, rural or urban, that lacks habitat. Photograph by the Xerces Society / Jessa Kay Cruz.

looking at these features.

In one of the first hedgerow projects I supported during my Xerces tenure—a dusty half-mile roadside planting next to a California tomato field—litter used to accumulate around the newly installed transplants. Weeds and careless drivers menaced the hedge constantly, while ground squirrels found choice meals in the roots of our trees and shrubs. And yet, year by year, the hedge grew. In the third year after planting, field surveys of bees revealed a doubling of their numbers at the site. By the fourth year, the hedgerow plants towered above my head, while coyotes and quail would intermittently peek out of the undergrowth, and kestrels circled overhead. Success stories like this are commonplace when it comes to hedgerow planting.

Zooming out, the greatest hedgerow success story of all might just be the fact

that they are still with us. Centuries of changes to our landscapes from agriculture, development, and, in some places, warfare, have laid waste to the hedgerows. Yet today hedgerows remain, cutting across farmland and through towns. Perhaps hedgerows—capable of taming dust storms, increasing the numbers of wild bees, delineating property boundaries, blocking offending views, providing renewable wood materials, suppressing crop pests, and offering homes for hummingbirds—may have stuck around over the centuries because thorny living fences are, still, the best way to hedge our bets in favor of food, farms, and nature.

Eric Lee-Mäder is principal and co-founder of Northwest Meadowscares. He worked for the Xerces Society for fifteen years before leaving to focus on his business.

Pollinator Protection:

A Choose Your Own Conservation Adventure

Aimée Code

When I was young, I loved reading the *Choose Your Own Adventure* books. Sometimes I selected bold options, charging ahead to save the day. Other times I was more cautious, choosing to regroup with my allies to strategize. Even when my choices led to a less than desirable ending, I could always try again. Recently, while talking with a woman about ways she could protect pollinators from pesticides in her community, I realized that invertebrate conservation has a lot in common with the *CYOA* books: there are myriad choices as to how to address the threats faced by invertebrates—and our choices really do change the outcome.

Most scientists agree that the main threats to invertebrates are habitat fragmentation and loss, declines in habitat quality, climate change, and the widespread use of pesticides. As a member of Xerces' pesticide reduction team, I'm keenly aware of the risks posed by pesticide pollution—whether from insecticides, herbicides, or some other category of “-cides.” Some pesticide uses have caused large bee kills. Others have impacts that are subtler but equally troubling, such as reduced reproductive success, which leads to fewer offspring.

To better understand the real-world exposures and risks faced by pollinators, we joined up with researchers from the University of Nevada Reno to sample for pesticide contamination across diverse

landscapes from wildlife refuges to agricultural fields to backyards, and even in nursery stock. Our findings, reinforced by other studies, indicate that pesticides are found in pollinator habitats nearly everywhere, contamination that too often is at levels known to cause harm.

While the ubiquitous presence of pesticides can feel daunting, there are many ways to be part of the solution. Everyday people are choosing their own conservation adventures, forging ahead with efforts to reduce pesticide use and to better support the many beneficial insects that make up thriving ecosystems.

One way that farmers are bringing biodiversity back to working lands is through establishing habitat such as insectary strips and beetle banks within or adjacent to their crops. Insectary strips—linear plantings of wildflowers along the edge of a field or through the middle between crop rows—are a long-established way to support beneficial insects. Beetle banks, though, may be new to you. These are low ridges planted with perennial native bunchgrasses to provide overwintering shelter for predatory ground beetles and other beneficial invertebrates. These banks promote the movement of pest-eating predators into the crops. Thus, when beetle banks are present on farms, predators have more opportunities to colonize crop fields and regulate crop pests, thereby limiting the need for pesticide use. By adding

flowers to a beetle bank you can choose to double the benefit, drawing in pollinators and a broader array of insects that act as natural enemies to pests.

A growing number of farmers are opting out of using pesticide-coated seeds. The practice of prophylactically coating crop seeds with insecticides—just in case a pest might be present—has been on the rise, with more crops than ever being registered for seed treatments. Unfortunately, such treatment is linked to contamination of waterways as well as flowering habitat near fields, which has led some farmers to become uncomfortable with the consequences of applying toxic insecticides to every seed they plant, while questioning why they need to spend the extra money to use potentially harmful pesticide treat-

ments when there might not even be a pest to defend against. Their thoughtful planning around pest management is good news for biodiversity.

Despite some farmers moving away from using them, pesticide-coated seeds are being planted across hundreds of millions of acres each year. In response, a few states are recognizing the value of improving oversight of the practice. Both New York and Vermont recently passed laws to ensure that seeds coated with long-lived neonicotinoid insecticides are planted only when crop pests are in evidence. These new laws are a tremendous step in the right direction: to reduce broad-scale pesticide contamination in the environment and to ensure that more ecologically sound decisions are being made about pest management.



Farms of any size can incorporate habitat. The long grasses on the left are on top of a beetle bank, a valuable pest-management tool that reduces the use of pesticides. Photograph by the Xerces Society / Sarah Nizzi.

For perspective on the impact of these laws, seed coated with neonicotinoids has been the single largest source of reported insecticide use in Vermont, but with this new law in place the use of neonicotinoid-coated seeds will occur only when there is a known pest to contend with. These common-sense bills were passed because of the dedicated efforts of dozens of organizations and thousands of people.

Towns and cities also offer opportunities for people to support bees, butterflies, and other wildlife. Outdoor spaces—from backyards to community gardens to parks to business landscaping—can provide pollinator habitat. Part of establishing healthy habitat for wildlife includes incorporating non-chemical pollinator-friendly practices to manage unwanted insects or other “pests.”

If you have space to grow some plants at your home or work, whether it

be a small balcony or a large yard, you can provide habitat for pollinators. The value of that habitat will be improved by preventing pest problems and avoiding pesticides. To further expand the impact of your own habitat, consider coordinating with your neighbors. Years ago, the residents on my block agreed to have our yard maintenance be pesticide free. It started when a young boy dressed up in a suit and went door-to-door asking that we help save the bugs by stopping our use of pesticides. All these years later, the simple pledge persists. When a new neighbor moved in, he started applying weed and feed to his lawn. After I explained the neighborhood pledge, though, he agreed to go pesticide free. The very next week I saw him in his yard with a long-handled dandelion digger. He also planted some shrubs and a vine maple that are native to this area. This spring his vine maple was full of pol-



Filling the spaces in which we live and work with flowering plants brings many benefits—habitat for pollinators, beauty, improved emotional health, and more. Photograph by Matthew Shepherd.



Chemicals affect areas beyond where they are applied. Grass strips and other buffers are part of the solution to protect sensitive sites. Photograph by Karin Jokela.

linators. If you know your neighbors, choose to talk with them about making your neighborhood into a pollinator haven by planting more attractive plants and avoiding pesticides—and if you don't know your neighbors, this is the perfect excuse to build connections along your block.

Or maybe you want to make a change in an area that extends beyond your neighborhood. That's exactly what the more than four hundred Bee City and Bee Campus affiliates are doing. Xerces provides the framework and sets the basic requirements—create habitat, reduce pesticides, engage in outreach—but how that work is done is up to each affiliate, and every community brings its own flavor and personality to pollinator conservation. The most recent reports from affiliates show that, collectively, they took more than eight hundred distinct actions to better protect pollinators. All of those efforts by affiliates add up to real change. Some communities eliminated pesticide use;

others switched to organic practices. Further affiliates are greatly reducing the use of pesticides and employing them only as a last resort, or halting applications for purely cosmetic reasons.

In Winston-Salem, North Carolina, for example, a discussion about how the city could cut back on the use of pesticides for routine land management resulted in the purchase of an industrial weed steamer. The city estimates that it will reduce herbicide use by 20 percent, using nearly 375 fewer gallons of herbicide annually. The city also overhauled its landscaping rules, passing an ordinance to allow natural landscaping. Residents can now plant their yards with native species and have lawns taller than eight inches without worrying about a visit from the city's code-enforcement staff. (If you are looking for some inspiring reading, you can find the reports and affiliate profiles on the Bee City USA website, beecityusa.org.)

Whether you are a gardener buying a few plants for your yard, or a city



Cities can leverage their purchasing power by asking nurseries to grow bee-safe plants for local projects. Photograph by the Xerces Society / Angela Laws.

employee procuring thousands of them for parks and street landscaping, another layer to protecting pollinators is finding plants that are safe for them, since research has shown that pollinator-friendly plants grown by nurseries can be heavily contaminated with pesticides. As a consumer, you can talk with your nursery about how the plants they sell were grown. (Our Bee-Safe Nursery Plants campaign offers guidance on doing this; you'll find information on our website, xerces.org/pesticides.)

Fortunately, many native-plant nurseries are conservation minded and it is becoming easier to find bee-safe plants. After learning about how pollinator-attractive plants can be contaminated, our nursery partners let us know about their actions to curtail pesticide use and pursue more ecologically sound practices. We heard from nurseries that improved soil health and fertility, chose organically approved pesticides, limited fungicide use, and planted flowers

to draw in beneficial insects that control pests. Your purchasing choices can support conservation by encouraging more growers to adopt such practices in their plant production.

Jointly, all of these actions are incredibly powerful. The Tanzanian proverb “little by little, a little becomes a lot” is important to remember in conservation. Everyone can use their own skills and interests to be a part of the solution, moving us steadily forward. So, if you haven't already joined us, we invite you to choose your own conservation adventure. With each small success we get closer to the tipping point where ecologically sound pest management becomes the norm, making our environment safer for everyone.

Aimée Code leads the Xerces Society's pesticide reduction team and is focused on securing practices and policies that promote ecologically sound pest management.

Small Spaces Bring Big Benefits for Small Animals

Matthew Shepherd

Anyone who has visited an IKEA store will have seen the demonstration apartments, a series of spaces each laid out with all we need to live: a place to sleep, somewhere to store food and to eat, a spot to sit and rest, a corner where children can play. Gardening for insects is a bit like that. Insects are small and don't need big places to live: they just need the right combination of features to support their lives.

Any of us with a yard, however tiny—or even just a deck—can take steps to help insects. You can approach it like those demonstration apartments and create a small living space for insects that is filled with what they need: somewhere to feed, somewhere to shelter, a place for their offspring. Grow a few carefully selected flowers and you will

provide food for bees or butterflies. A log pile, rock mound, or other structure will provide shelter for rearing a family or surviving winter. Keep plant stems through fall and winter, and by doing so you create nesting sites for mason bees and others. Leave some leaves in your flower border or planter, and you will offer a hideaway for fireflies or overwintering bumble bee queens. Mow less to allow flowers to bloom in your lawn, and you can feed some bees and flies (and save yourself time and money).

The larger your space—it doesn't have to be your own garden; you can do this in a community garden or park, in business landscaping, or on a college campus—the more habitat you can create, but even in a modest area you can take the same approach to assemble



Native plants, fallen leaves, flower stems, grass tussocks: an insect paradise in a small suburban yard. Photograph by Matthew Shepherd.

small spaces that support insects. A central principle is that it is necessary to provide the conditions that will support the entire life cycle of the animal. If you want butterflies, you need to have the plants their caterpillars eat and somewhere for them to shelter as chrysalises. If you want bees, you need to have the bare ground or the hollow stems in which they can nest. If you want insects, avoid insecticides.

Flowers are a great place to start when thinking about creating a garden. They are a fundamental component of habitat, providing food, shelter, and nesting opportunities, and, of course, beauty for us to enjoy. Contact with greenery and nature also brings emotional and mental health benefits to people. Whatever the size of your space, plants are the perfect complement to the other habitat features.

Native plants—those that naturally occur in the region in which you live—are the best option. There is plenty of evidence that native species support a greater diversity and abundance of insects than do non-native ones. They also can be easier to grow, since they are adapted to your local environment. You'll still want to match them to your particular growing conditions, as you would in choosing any plant: soil type, moisture, shade level, and wind exposure all impact what will be successful.

Hedgerows (discussed earlier in this issue of *Wings*) can be a lovely element to add to any garden. They make a wonderful way to divide larger yards into a series of “garden rooms.” In smaller yards, they may be best planted along the edges, creating a visual frame. Hedgerows can also be planted where trees might not be appropriate, such as



Flowers, particularly native species, form the foundation for any wild-life garden. Photograph by Matthew Shepherd.

beneath overhead utility cables. Should you have enough space, a strip of perennial flowers and grasses growing beside the shrubs will add to the value of the food and shelter provided.

Plants do double duty for the tiny creatures in your garden. An obvious benefit is the nectar they offer that feeds adult insects, but plants also support the next generation, in particular the caterpillars of both butterflies and moths. Caterpillars need the right species of plants to be able to feed. Indeed, some are pretty particular, eating only one or a small number of species. The monarch is a well-known example, needing milkweed (*Asclepias*) or a few closely related plants such as honeyvine (*Cynanchum*) for its caterpillars. Other butterflies are less picky; caterpillars of the grey hairstreak, for instance, are known to eat dozens of different plants from multiple families. And we shouldn't consider flowers as the only possible host plants, since, for example, many skippers feed on grasses, and tiger swallowtails munch on a range of trees. All of this might seem a lot to think about, but by focusing on growing native plants, we can easily provide caterpillar food for a large number of species.

Bees also benefit from more than just nectar. The flowers in your garden can provide the kitchen, nursery, and bedroom for native bees. The vast majority of the thousands of bee species are solitary, with each female creating a nest that contains a small number of brood cells. She forages on flowers to collect nectar and pollen with which to stock each cell before laying an egg. Almost a third of bee species nest in tunnels in the center of plant stems or pithy twigs, old tunnels created in snags by boring



Hollow stems of wild indigo provide nesting sites for solitary bees. Leaving such stems is a simple way to create habitat. Photograph by Matthew Shepherd.

beetles, and similar openings, which are divided into brood cells with materials gathered nearby, including leaf or plant parts.

Instead of cutting back everything at the end of summer, leave the stems of perennial plants. The seed heads will feed finches, sparrows, and other birds, while the stems will provide some shelter. Once the temperatures in spring are reliably in the fifties (above ten degrees Centigrade), cut them to eight to eighteen inches (twenty to forty-five centimeters) high. Those old stems can become nests for many of our solitary native bees. The plants will grow up around them and you'll not know they were there, but the bees will.

Of our other bees—roughly 70 percent of species—almost all nest in the ground, excavating narrow tunnels off of which they create brood cells. Access



Stacked logs from pruning an overgrown apple tree create shelter for small wildlife. Photograph by Matthew Shepherd.

to bare soil is essential for these species, but thanks to the availability of such landscape materials as bark chips, lava rock, river rock, marble chips, etc., this is something that many gardens lack. Bees don't need extensive areas of soil, although they do need access to the surface. They will nest in the gaps between paving slabs, for example, and if you have larger rocks or chunkier bark, they can crawl between the lumps. They'll also happily nest in areas with sparse vegetation or in the soil between your pollinator plants. The key is to use landscape materials sparingly in order to ensure that you don't blanket the ground.

If you want to be proactive and create a ground-nesting area, select a sunny spot with well-drained soil—a south-facing slope may be ideal—and remove most of the vegetation. If erosion is a concern, retaining some plants or adding native bunchgrasses will reduce the risk. An alternative is to create a mound of soil or to dig a small pit or trench and fill it with a mixture of sand and loam.

There are a growing variety of commercially manufactured insect homes and other structures available, which can be an attractive addition to a garden but which don't always bring great benefit for their intended residents. Simple structures such as a pile of logs or bricks made with scraps and easy-to-obtain materials can better provide the shelter that insects (and other invertebrates) need. These are quite simple to create and require only modest spaces—small enough to fit on an apartment deck or between plants or other items in your yard. You could use firewood, branches from pruning, rocks, paving slabs, bricks, concrete blocks, old fence boards, repurposed home-decor items—anything you have that will allow you to make a structure that has gaps and crevices. The insect home can be as large or as small as the space allows, and as neatly or informally constructed as you want. If there are gaps between larger pieces, push in straw, long grass, twigs, or small stones to create even smaller

spaces. In large yards, should branches or trees fall or you have reason to remove a tree for safety reasons, retain some logs on the ground.

Such structures offer winter refuge to butterflies and a wide range of other tiny animals, and will provide nesting and nighttime shelter to still others. In addition to the tunnel- and ground-nesting bees already mentioned, there are bumble bees—almost fifty species in North America alone—whose queens seek out a small cavity for their annual colony. Piles of rocks or branches can provide the spaces they need.

Sometimes creating better habitat is achieved by doing less. There are many invertebrates that benefit from us hanging up our rakes or turning off our leaf blowers. Some we notice, such as the fireflies whose lights flicker in the evening darkness; as larvae they hunt through leaf litter and other damp places. Similarly, luna moths pupate in litter, their cocoons wrapped in leaves; and the red-banded hairstreak, a butterfly with a wingspan about the width of your thumb, lays its eggs on fallen leaves of wax myrtle, sumac, and oak.

Others, such as springtails and roly-polies, will be largely unseen, helping with decomposition or being eaten by birds, but all are essential pieces of a healthy environment. This fall, instead of clearing away all your leaves, is there a place you can keep them? Don't leave them where they will be a problem (no blocked drains!) or if there are issues with plant disease, but surely you have a place to keep some. A thin layer won't kill your grass. Use them to mulch your flower borders, pile them at the base of a fence or shrubs—or beside your rock or log pile.

With all of the above, we also need to consider protection from pesticides. We can create the perfect physical space, with the ideal selection of flowering plants and nest sites and shelter, but if it is contaminated with toxins, it is not a healthy place for insects. The good news is that, because you've decided to create a wildlife garden, you're already taking preventive steps. Native plants often have fewer pests, and choosing plants appropriate for your growing conditions reduces stress and thus the pressure that pests can put on them. You'll also learn



The red-banded hairstreak lays its eggs on fallen leaves. Photograph by Bryan E. Reynolds.

which plants do better or worse in your growing space, and over time you can focus on the successful ones; growing plants suited to the conditions you have is better than changing the conditions to suit a plant. Being tolerant of chewed or tatty plants means less need for treatment—and, honestly, holes in leaves is evidence of healthy caterpillars or bees taking nest-building materials, a sign that you are being successful!

Any gardener can tell you that their garden is never finished. There's always one area that needs attention, or a plant that can be replaced with something better suited to the spot. Wildlife gardening is the same, a constant process of tinkering and change. As you consider what you can do, remember that you don't have to do it all in one go. Look at your yard and see what's possible to do this year. Then decide what you might do the next year and the one after. There's a good chance that in working to help wildlife, your yard will end up looking quite different from those of your neighbors. It can be helpful to add a sign or similar indication to explain

why, to let people know that your landscape is the result of a series of conscious decisions and not of neglect.

I've lost track of how many times a conversation about pollinator gardening has circled around to the question of whether an area is big enough to have an impact. People worry that their garden is too small to support wildlife, or that what they can do isn't enough to be noticeable. What you do in your space may seem insignificant, but insects are small and will make use of whatever you can offer them, and you'll be able to see the direct benefit. If people across your neighborhood—you, your neighbor, your friend down the block—are doing it, the tiny places combine to create a patchwork of small insect apartments that collectively can support healthy populations of wildlife.

Matthew Shepherd learned gardening at his mother's side in an English cottage garden and has created wildlife gardens everywhere he has lived. He is director of outreach and education at the Xerces Society.



Gulf fritillary caterpillars eat passionvine, an increasingly popular garden plant. Photograph by Bryan E. Reynolds.

STAFF PROFILE

Lisa Merkhofer, Conservation Data and GIS Analyst

What got you interested in invertebrates?

Ever since I was a kid, I have been engaged by animals. My mother allowed us to have almost every kind of pet except a dog; sometimes my house felt like a zoo and I loved it. As I grew older, I became more interested in learning about animals in their native habitats. It was not until I studied paleoecology that I came to fully appreciate insects (and invertebrates in general) as foundational to biodiversity conservation.

When I was in graduate school, I had an opportunity to participate in a dig in Patagonia to expose a fossil forest from the Paleocene, the era right after the extinction event that led to the demise of the dinosaurs. We were looking for fossil leaves with insect damage, to use as a proxy for overall insect diversity. Then, just as now, insects were the basis of the food chain.

What do you do to relax? I love to start my day by doing a little yoga. I think it is a great way for me to mentally reset for the day while also getting in some stretching and flexibility training. My cat also enjoys it when I do yoga and tries to climb on me while I am trying different poses, which while not always relaxing, adds to the challenge.

What book are you currently reading? One book that I'm reading is *Sisters of the Earth*, edited by Lorraine Anderson, an anthology of nature writing and poetry by women writers that has some really inspiring pieces. I like to pick it up



when I want to be reminded of how awe-inspiring the natural world is and to recognize my connection with it.

What's your favorite place to visit? That's a hard one! I love exploring wild places and spending time in nature. My partner and I recently traveled to Georgia (the country), which was amazing. We went trekking in the Greater Caucasus mountains on the border with Russia, where there are beautiful glaciers and historic villages in which you can spend the night. I also really enjoyed the Georgian food, which is heavy on fruits and vegetables, even in the mountains.

What music do you enjoy listening to? I love bluegrass music, especially with fiddles. I tried to play the fiddle for a while but gave it up for the good of the neighbors.

PARTNER SPOTLIGHT

Bee City USA and Bee Campus USA Affiliates

The passion, energy, and dedication that the more than four hundred Bee City and Bee Campus affiliates bring to pollinator conservation is truly amazing. We don't have space to share the work of every community, but can highlight some of the projects that one city and one campus each did last year.

The City of Mountain Brook became the first Bee City in Alabama in February 2023—and by April it had already unveiled its first native pollinator garden outside the City Hall. In June, the city hosted a highly successful native plant giveaway. All available plants were claimed within forty-five minutes, but city staff remained for three more hours to answer questions about plants and pollinators. This and other outreach built considerable engagement in the work of the Bee City committee and sparked projects by both Girl and Boy Scouts. The city is also reaching out to other communities. Mountain Brook may have been the first Bee City in Alabama, but it is determined not to be the only one!

At the University of Louisiana at Lafayette, a Bee Campus since August 2022, five pollinator gardens were expanded and two new ones created at both residential and academic facilities across the campus. This work was done through service-learning opportunities and by local volunteers. Other ways of including the community and raising awareness included visits to grade schools, tabling at events, and campus

tours. A major achievement was the adoption of the first integrated pest management plan for the campus in coordination with the grounds services section of UL Lafayette's Office of Facilities Management. The plan emphasizes prevention over treatment, established a ban on the use of neonicotinoids, and initiated an ongoing discussion about adopting organic ground management.

The Bee City and Bee Campus program unites people across the country with a shared mission of protecting pollinators. Together, they are creating real and meaningful change. We thank everybody who is involved for their impactful work.



Photograph courtesy Bee City USA, Mountain Brook, Alabama.

Taking Action to Protect Declining Species

Marking another success for Xerces, the U.S. Fish and Wildlife Service announced in October that it was proposing to protect the Bethany Beach firefly (*Photuris bethaniensis*) as “threatened” under the Endangered Species Act—the first firefly to receive ESA protection. This action came in response to a petition submitted by Xerces and the Center for Biological Diversity. The Bethany Beach firefly is found only in wetlands among sand dunes in Delaware, Maryland, and Virginia. The Atlantic shore is under great pressure from development, and remaining habitat is impacted by multiple threats, including construction, recreation, light pollution, and pesticides.

Other species that we are fighting for include four additional fireflies, a butterfly, and a bumble bee. We have submitted ESA petitions requesting protection for each of these animals, and this year we received positive ninety-day findings (a bureaucratic term that means the USFWS agrees that there is evidence of decline and will conduct an in-depth review of the insect’s status) for two of them, the Southwest spring firefly (*Bicellonycha wickershamorum*) and the Florida intertidal firefly (*Micronaspis floridana*). The Southwest spring firefly is known from three dozen locations in Arizona. Drought, trampling by cattle, recreation, and copper mining are some of the many factors impacting its wetland habitats. The Florida intertidal firefly is found in mangroves and salt



Bethany Beach firefly. Photograph by Jason Davis, Delaware Department of Natural Resources and Environmental Control.

marshes on both the Atlantic and Gulf sides of the Florida peninsula, where the larvae, which glow in the dark, search for snails to eat near the high-tide line.

We are still waiting for decisions on the other species. The mysterious lantern firefly (*Photuris mysticalampas*) occurs at half a dozen floodplain wetlands in Delaware and Maryland, not far from the Bethany Beach firefly. The loopy five firefly (*Photuris forresti*) is limited to just over a dozen wetland sites, in Tennessee, South Carolina, and Georgia. In contrast, the large marble butterfly (*Euchloe ausonides*) is found in sixteen states; in some areas it has declined by more than 80 percent. The Morrison bumble bee

(*Bombus morrisoni*) is also widespread across western states, but has declined by more than 70 percent and is found in only a third of its historic range.

The other decision we are anticipating is an announcement in early December from the USFWS about whether

or not the monarch butterfly (*Danaus plexippus*) will get the protection it deserves. This follows a petition submitted in 2014 by Xerces and conservation partners and comes four years after the Service said protection was “warranted, but precluded” due to other priorities.

Western Rangeland Protected from Spraying

The Xerces Society seldom resorts to court action. When we do, it is normally either a procedural step or as a last resort to halt environmental harm after we have tried to work within the system with the agencies in charge.

In August, the Xerces Society and the Center for Biological Diversity, represented by Advocates for the West, won a lawsuit against the Animal and Plant Health Inspection Service over its policy of spraying to kill native grasshoppers and Mormon crickets on millions of acres across seventeen western states. For years, APHIS has brushed aside re-

quests for changes to its spraying programs. Our efforts to obtain completed maps of spray areas and advance notice of spray actions were routinely thwarted, which had the effect of prompting Congress to issue a statement directing APHIS to conduct its operations with greater transparency.

In the court case, a federal district court judge in Oregon found that APHIS violated the law by focusing only on spraying insecticides in order to suppress grasshoppers and Mormon crickets, and that the agency ignored “any pest management techniques other



A recent court decision will change how insecticide spraying across millions of acres of western rangelands is managed. Photograph courtesy BLM.

than the application of pesticides.” The court ruled that APHIS must do a better job of assessing risk to wildlife and other sensitive environmental resources.

Some areas affected by APHIS spraying programs are home to a thousand or more species of native bees, many of which, like the Morrison and western bumble bees (*Bombus morrisoni*, *B. occidentalis*), are in decline, yet APHIS has continued to spray within the habitats of at-risk species. The agency’s assessments of impacts from its spraying on recreational areas, drinking water source-

es, and culturally important areas were also inadequate. The ruling means that the agency will have to consider these impacts and reconsider its “spray-first” approach to grasshopper control.

The outcome from this court case will reshape grasshopper management for the better, helping APHIS move away from an unsustainable reliance on pesticides and broaden the tools it uses for this purpose. Ultimately, this will contribute to the well-being of pollinators, birds, fish, and other wildlife across millions of acres of western rangeland.

Establishing Insect Authority in All U.S. States

“Insect authority” might be a rather bland-sounding phrase, but a lack of such authority prevents a number of U.S. states from taking action to protect butterflies, bees, and other insects. Because these states do not recognize insects as wildlife under state law, state agencies are unable to include insects—the majority of wildlife species!—in managing and conserving wildlife and natural areas. Even the rarest and most endangered of species may not get funding or staff attention, leaving them extremely vulnerable.

Xerces is working to change this situation, including participating in a series of court cases in California that, in September 2022, led to protection for four bumble bees in the state. That action confirmed that the California Endangered Species Act did extend protections to insects, an issue that had been argued over since the legislation was enacted in 1984.

In May of this year, Governor Polis of Colorado signed into law an act that gave Colorado Parks and Wildlife the au-



The large marble butterfly is widespread but declining; it would benefit from state-level conservation. Photograph by Tony Iwane / CC BY-NC 2.0.

thority to study and conserve pollinating insects and other invertebrates (and also rare plants). This was a direct result from our work on the Colorado Native Pollinating Insects Health Study, which was released in January.

Eight additional states lack insect authority. We are working in three of

Your Legacy for Invertebrates



This is John, our little dog, Banjo, and myself in our backyard. We converted our lawn to habitat for insects and other wildlife in the early 1990s. It wasn't long before insects, birds, and other creatures became our neighbors. We enjoy each and every moment with these amazing creatures, but they made me think of the future.

We have seen gardens change after friends moved from their homes. Some became lawns again, while others were cut back or disappeared slowly.

The Xerces Society is in our will because it gives us hope for the future. Xerces will be there for the "little things that run the world." Its work will continue to help insects and invertebrates when we are gone. And that makes my heart sing.

—Pat Thomas, Duluth, Minnesota

Loyal Xerces member since 2001, whose favorite insect is the ambush bug



Connect with Melissa at engagement@xerces.org
or visit xerces.org/donate/planned-giving.

them—Pennsylvania, New Mexico, and Nevada—to build coalitions of organizations and individuals to support bills that have already been introduced, or to assist with drafting bills for intro-

duction. Given the continuing declines in invertebrates seemingly everywhere surveys are done, ensuring that all U.S. states can play a role in their recovery is an increasingly urgent task.

Living Snow Fence Helps Crops and Insects

Staff from Xerces' pollinator team have helped farmers and ranchers to plant many miles of hedgerows. The benefits to wildlife and from wind protection are long established, and it's now recognized that shelterbelts also help retain moisture for crops and increase carbon capture. We recently collaborated with Doug Crabtree and Anna Jones-Crabtree of Vilicus Farms, a 12,500-acre organic dryland farm in northern Montana, to plant a multi-purpose shelterbelt.

Thanks to a Conservation Innovation Grant from the USDA Natural Resources Conservation Service, Xerces designed an experimental windbreak to boost biodiversity, catch snow for moisture retention, and increase carbon sequestration. Fifteen feet wide and seven

hundred yards long, the shelterbelt consists of two parallel hedges. One row is Siberian pea-shrub, a naturalized shrub that Doug and Anna knew would grow well; the other a mix of shrubs and small trees, eleven native and one naturalized. Planting was done in fall 2023 in partnership with Mad Agriculture and the Montana Conservation Corps.

Given its experimental design, we continue to monitor the site. Baseline measurements of pollinators, soil carbon, and rates of water infiltration were taken at planting, and Xerces staff visit in spring and summer to check the plants and observe the pollinators. This summer, most of the plants were well established and growing new leaves, and some were already blooming.



A tractor-mounted auger made planting easier in the clay soils. Photograph by the Xerces Society / Lea Van Es.



The research of both DeWind awardees will help to advance moth conservation. Photograph by Karin Jokela.

The 2024 DeWind Awards

Helping to build the next wave of butterfly and moth conservationists, the Xerces Society's DeWind Awards are given to students pursuing research into Lepidoptera conservation. The 2024 awards, each worth \$10,000, went to Lillian Hendrick and Lucy Guarnieri, both of whom are studying moths.

Lillian Hendrick is a PhD student at the University of Florida researching micromoths—moths with wingspans that often are under four-tenths of an inch (ten millimeters). Lillian's research will study micromoths across a range of habitat types from rural to urban. In addition to identifying the species at the survey sites, her project will garner basic knowledge about potential changes in each species' phenology (when in the year adult moths are out flying). Lillian will also test moths for the presence of *Wolbachia*, a bacteria that often causes several (mainly negative) effects on reproduction of infected individuals.

Lucy Guarnieri is a graduate student at Ohio State University looking into how cities can support more moth species. Lucy will compare which species live in different areas of central Ohio, to determine how different habitat management strategies and habitat sizes affect moth diversity. Monthly surveys during the summer in a combination of managed grassland-style parks, urban pollinator gardens, and mowed turf fields will allow Lucy to compare how the species change between habitats, and how factors like flower abundance and light pollution levels influence moths.

In communities everywhere, people are creating habitats for pollinators, but the main focus is on bees, butterflies, and other daytime species. These two research projects will expand knowledge of a group of insects that is frequently overlooked, which will lead to habitats that support a greater diversity of pollinators.

Short Bites

Bug Banter: Xerces' podcast celebrated the completion of its first year of broadcasts in September, having reached fifty thousand listeners. Cohosts Rachel Dunham and Matthew Shepherd have had conversations with numerous other Xerces staff members about butterflies, fireflies, bumble bees, mosquito control, spiders, wasps, and more. The second year has started with episodes featuring non-Xerces guests talking about moths and the importance of invertebrates for migratory birds. For information, visit xerces.org/bug-banter, or search for Bug Banter wherever you get your podcasts.

Recent publications: Xerces has developed an extensive collection of plant lists, fact sheets, and other publications,

all of which can be freely downloaded from the publications library on our website, xerces.org. Recent additions to this resource include a fact sheet with advice on creating habitat for pollinators and other beneficial insects using plugs (small container-grown plants), as well as two about protecting pollinators from pesticides with guidance on rethinking weed management in gardens and how to respond to insects and diseases on landscape trees and shrubs. Also, thanks to partners in our firefly conservation effort, we now have our fact sheet on firefly-friendly lighting practices available in Flemish—*Help Nachttjuwelen te Beschermen: Vuurvlievriendelijk Lichtgebruik*—in addition to English and Spanish.

Become a Xerces Member to Receive Your Biannual Copy of *Wings*!

Wings is published twice a year by the Xerces Society, an international, donor-supported nonprofit organization dedicated to protecting the natural world by conserving invertebrates and their habitat. A Xerces Society membership starts with a suggested tax-deductible donation of just \$35 per year and includes a subscription to *Wings*. To become a member or to make a gift to support your favorite invertebrates, please visit xerces.org/donate.



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



The fiery searcher (*Calosoma scrutator*) is a helpful predator to have around. Although classified as a ground beetle, it regularly climbs trees and shrubs when seeking its caterpillar prey. Photograph by Bryan E. Reynolds.

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On the cover: Benefiting from pollinator gardens planted in towns and cities, the gulf fritillary (*Agraulis vanillae*) is becoming increasingly common in neighborhoods around many areas of the United States. Photograph by Bryan E. Reynolds.