WINGS

ESSAYS ON INVERTEBRATE CONSERVATION

THE XERCES SOCIETY SPRING 2017

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Conservation Built on a Scientific Foundation

Scott Hoffman Black

Science is the foundation of our work here at the Xerces Society. From unraveling the intimate relationship between bees and flowers, to understanding the lifecycle and habitat needs of rare stoneflies, to working out why monarchs migrate to overwintering sites—and how they reach them—the work of scientists has helped to explain and illuminate the natural world. Science underpins everything we do, informing our projects and directing us toward successful solutions.

We undertake applied research to determine the extent of declines for bumble bees, freshwater mussels, butterflies, and many other invertebrates. We work with landowners and land management agencies to determine where at-risk species occur, so that we can target conservation dollars to protect their habitat. We monitor restoration sites to make sure that our efforts produce effective results. Beyond our own studies, we collaborate with researchers at universities around the world to advance the science of invertebrate protection. Whether it is working to protect bees from toxic pesticides, to improve habitat for the maximum benefit of pollinators, or to understand the influence of climate change on butterflies, we promote evidence-based policies and practices.

We harness the power of thousands of people throughout North America to gather valuable conservation data. Through Bumble Bee Watch, individuals from all walks of life help identify

From the day it was founded in 1971, the Xerces Society has built its conservation efforts on a firm foundation of knowledge and scientific evidence. Here, staff and volunteers are gathering data on a population of freshwater mussels. Photograph by Dick Dewey.

the locations of rare bumble bees—the first step in protecting these bees and managing their habitat. Pond Watch participants help to unravel the mysteries of dragonfly migration, and volunteers who count monarchs at overwintering sites help us to prioritize restoration projects to protect these beautiful butterflies. Engaging the participation of others in this essential work is vital to our conservation success, in that it multiplies the amount of data available—and helps to build an ever-greater constituency for insect conservation.

Almost everyone wants to plant flowers on farms, along roadsides, in school gardens, and around their yards to help pollinators. This level of enthusiasm is fantastic, but to bring the greatest benefit to bees, people need access to accurate information on what to plant and how. By drawing on the work of our academic partners as well as on our own planting trials, we can provide the most practical advice for a range of situations. And we go beyond flowers to offer guidance on creating nesting sites for bees and protecting habitat from pesticides.

At Xerces we work on solutions. Taking a deliberative approach to our work and using the relevant science requires extra effort and may mean that ours is not the first organization to speak out on any given issue, but it leads to long-term success. In the conservation world, the Xerces Society has become the go-to source for reliable and accurate information on invertebrates, and our outreach and education creates effective results. We have protected dozens of at-risk species and tens of thousands of acres of the wildlands they need to survive. We have worked with agencies and farmers to restore hundreds of thousands of acres for pollinators. We have trained more than eighty thousand people through face-to-face workshops, short courses, farm tours, field days, and conferences. Our resources have reached hundreds of thousands more—empowering all to be part of the solution.

All this comes from science. Yet, if you listen to current rhetoric, you might think that science is a distraction from reality, or a ploy that is used to justify burdensome regulations. We live in a time when the value of science is often dismissed, research is sometimes questioned in order to plant seeds of doubt, or evidence is cherry-picked or distorted to fit desired outcomes. But the truth is that science aids us in many ways, and this seems to be a time when science needs our help. Speaking up for fact-based investigation will support all fields of endeavor, not just conservation.

This issue of *Wings* is about conservation on farmlands, including creating areas of habitat on farms and understanding and reducing the impacts of insecticides, but at their core these essays are about the application of science. Whether we are working with a farmer in the upper Midwest to ensure that habitat becomes well-established and brings the greatest benefit to bees and other beneficial insects, or assessing how we can create networks of habitat across the vast Central Valley of California for the benefit of invertebrates, we draw upon years of research to guide us.

As we move forward, the work of the Xerces Society will remain founded in science, and we will continue to promote the importance of evidence-based conservation. We believe there is no better way to ensure that our work leads to enduring change.

Small Farms, Big Impact: Pollinator Habitat in the Midwest

Sarah Foltz Jordan

"Prairie!" Just that one word in the subject line of an email from Erin, a Minnesota vegetable farmer with whom I am working, and I knew it was going to be a great message. The email itself was a series of photographs showing a glorious shock of yellow and white: the early summer blooms of a native wildflower meadow we had installed on Erin and Ben's farm the spring prior. This email made my day because it was purely celebratory, at a time when my inbox was flooded with inquiries from farmers concerning weeds—how best to control them before seeding habitat, and how to deal with the big, bushy weeds so characteristic of areas of native planting in their first years of growth.

The year before, Erin's planting had been no different from these, a "problem child" for sure—covered in dense crab grass, which, when mowed to control seed set, responded by simply setting seeds lower to the ground. Thankfully, the crab grass itself is a winter-killed annual, and all that new grass

Habitats such as this wildflower meadow are possible thanks to the dedication and hard work of farmers. Though it can take a few years to see this much bloom, these projects are bringing landscape-wide change. Photograph by the Xerces Society / Sarah Foltz Jordan.

seed made little difference to the young planting the next year; our highly technical three-step approach—"mow, wait, and see"—had succeeded!

My work for the Xerces Society centers around creating and enhancing habitat for pollinators and other insects on farms in the Great Lakes region. This involves collaborating with farmers to prioritize conservation actions that best address the resource concerns and available space on their farms. For farmers growing such pollinator-dependent crops as apples or squash, there is strong interest in boosting populations of wild bees to ensure abundant fruit set.

A U-pick blueberry farm that I work with, Little Hill Berry Farm, is an excellent example of a crop management system that is highly dependent on bees for pollination. Many large-scale blueberry producers utilize managed honey bees to ensure that pollination needs are met. Native wild bees, however—such as mining, mason, and bumble bees—are well-known to be more effective than honey bees at pollinating blueberry flowers, and, when their habitat needs are met, can perform full pollination services. Unlike honey bees, which nest in boxes and may be carted onto the farm for a short period during bloom, native bees require a variety of nesting sites, as well as an ample supply of flowers for the duration of the growing season—before the blueberries bloom, and again long after the bloom is over.

In 2014, when I first visited Little Hill Berry Farm, we took some time to evaluate the existing habitat at the farm from the perspective of a pollinator. We found that although there were high-quality nesting areas for bees, food resources were often scarce during the entire length of the growing season. A few deciduous trees provided forage in

Xerces staff members work with farmers to develop successful organic techniques for the weed control and seedbed preparation necessary to establish wildflower habitat. Photograph by the Xerces Society / Sarah Foltz Jordan.

The shrubs in this hedgerow support insects and provide a range of edible fruits. Those include currant and juneberry, though the white flower heads of elderberry are most obvious. Photograph by the Xerces Society / Sarah Foltz Jordan.

early spring; the blueberry blossoms offered resources in late spring; and after that there was almost no food available other than a few stray goldenrod and milkweed plants in a weedy margin mostly dominated by invasive grasses. To address this deficiency, we planted five "insectary strips" running the length of the farm and evenly spaced across the fields, composed of more than fifty different kinds of native wildflowers and grasses. Now flowering, these strips provide a diverse, season-long food source for bees, while also giving the farm a more wild feel, adding beauty and interest to the U-pick experience. In addition, the habitat helps to hold soil, water, and snow in place, preventing erosion and resulting in more snow deposition on the blueberry plants for much-needed winter insulation.

Boosting populations of natural predators for pest control is another key objective of such plantings. This is particularly relevant for organic farmers, since they are typically using insecticides in a very limited way if at all, and are thus strongly reliant on having enough "good bugs" around to fight the "bad bugs." Many wasps, hover flies, and other predator and parasitoid insects feed on floral resources during part of their lives, so by including the favored flowers of these creatures in our plantings, we can effectively increase natural pest control in adjacent crop fields—a research-supported strategy, and one for which several of the farmers I work with are already reporting positive effects.

For example, at Uproot Farm, a diversified vegetable operation where we have installed habitat, the owner recently noted that this year, for the first time since the farm's establishment in 2009, she has not had to spray her spring kale and broccoli. Of course, lots of factors impact pest and predator cycles, but it is hard to believe that the flowers inte-

For many farmers, their personal connection to the land both inspires them to improve it for the next generation and justifies all the hard work that doing so entails. Photograph by the Xerces Society / Sarah Foltz Jordan.

grated directly into the brassica fields aren't helping, especially after seeing these flowers covered in wasps, lightning bugs, and lady beetles during my summer visits.

Happily, native habitat can also be designed to provide edible and saleable resources for farmers. It is amazing to me how many under-used nutritional and medicinal native plants are available to us, if we can keep that traditional knowledge alive and also prevent these highly valuable plants from fading out of our landscapes. At Prairie Drifter Farm, another diversified vegetable operation in central Minnesota, the farmers have dedicated an area to native hedgerows specifically designed to provide food for both humans and pollinators, including such plants as elderberry, wild plum, juneberry, and New Jersey tea.

Here and elsewhere, we have been trying out a variety of methods of organic site-preparation for establishing wildflowers. Because conventional herbicides are often the go-to solution for preparing a site for planting, organic farmers may find themselves with limited options and minimal guidance. To address this, Xerces staff across the country have been conducting field trials testing the effectiveness of organic weed-removal techniques, including solarization, smother cropping, and even pig rooting.

Ensuring that habitat is as sheltered as possible from pesticide exposure is a key component of any pollinator habitat project, irrespective of the type of farm. We do this by placing habitat in the most protected areas, and by working with farmers to develop integrated pest management strategies for their crops in an attempt to minimize the overall usage of pesticides.

At all of the farms where we install habitat, we further engage the local community by hosting on-farm workshops, field tours, and work parties at various stages of the restoration process, including during the not-so-pretty early years of site preparation and regular mowing. At these events, we provide farmers and farm agency staff (principally from the Natural Resources Conservation Service and Soil and Water Conservation Districts) with technical information necessary to help their future habitat installations succeed. Hands-on activities, such as broadcasting wildflower seed, ensure that participants enjoy direct experience with at least one step of the restoration process.

These events have been highly successful at encouraging others to pursue similar conservation actions on their lands. For example, following one of our monarch-conservation field days last fall, sixteen farmers in the surrounding area reached out to initiate habitat planning. The majority of these had either attended the field day, or were recruited by agency staff in attendance—and we have already moved forward to get native habitat in the ground at a few of these farms. This ripple effect across communities not only increases quality habitat for pollinators, but also improves connectivity of that habitat across a landscape, while building stronger farmer-to-farmer support networks for conservation.

Many growers choose to create habitat not merely to increase pollination support for crop production but also to help monarchs and other wildlife. Photograph by the Xerces Society / Sarah Foltz Jordan.

Across the Midwest, our plantings range from monarch meadows on dairy and row-crop farms, to beetle banks on vegetable farms, to a rather novel native understory planting currently becoming established as the ground cover for an apple orchard. Despite the practical benefits to crops resulting from this work, the most important factor in the motivation and long-term success of the habitat plantings is the genuine conservation ethic of the farmers we work with. These are farmers who view themselves as stewards of a piece of land for just a short period of its history, and they are committed to making that land better instead of worse for future generations. They recognize the practicality and joy of farming with nature, rather than against it. These are farmers who work harder and more skillfully than anyone I know, yet still find time to send celebratory emails about flowers, and to marvel at the buzzing of the bees.

Sarah Foltz Jordan is the Xerces Society's pollinator conservation specialist for the Great Lakes region.

Re-Flowering the Valley

Scott Hoffman Black

When he visited California in the late 1800s, John Muir encountered a remarkable sight: "At my feet lay the Great Central Valley of California, level and flowery, like a lake of pure sunshine, forty or fifty miles wide, five hundred miles long, one rich furred garden of yellow Compositae." This profusion of wildflowers bloomed in the spring, spreading across the drying tule marshes as the Valley transitioned toward the parched conditions of summer. Even in the hottest season, green riparian corridors snaked across the landscape.

Were John Muir to visit today, he would find the Valley dramatically changed. The marshes are gone, the rivers are hemmed in by levees and no longer free to meander across the land, and the wildflowers have faded. In their place are orchards of almonds, olives, and citrus; fields of sunflowers, tomatoes, carrots, and lettuce, as well as cotton and rice paddies; and vineyards. At the margins, where the land begins to rise, cows graze—often on introduced grasses.

The Central Valley is a vast trough nestled between the Sierra Nevada to the east and the Coast Range to the west, and marked at its north and south ends by the cities of Redding and Bakersfield. It is drained by two major rivers, the Sacramento and the San Joaquin, both of which empty into San Francisco Bay. The Valley is one of the most productive agricultural regions in the world, growing a third of the food that is trucked across the country, and fully 60 percent of the world's almond supply.

Urban areas have expanded across the region, and the Valley now supports a population of about six and a half million people. The growth of Sacramento and other cities has led to the loss of both agricultural land and native habitat. Where grizzly bears once roamed and condors soared, we now have a landscape from which much of the native biodiversity has been eradicated—a landscape that supports just a few species, and those are frequently nonnative.

Given the scale of all these changes, some might see the Central Valley as a lost cause. Can an area that has been so altered by humans, that is so relied upon for food production, and that is such a target for urban and suburban development, be restored to provide for biodiversity? I think the answer is yes—at least in part.

Although much of the Central Valley has been impacted by development, there are still remnants of the landscape of old—vernal pools, riparian corridors, wildlife refuges, small natural areas, and even some places on farms, along roadsides, and in parks and gardens. These areas harbor native plants and many small animals that pollinate, provide pest control, and offer sustenance for birds and fish.

Outside of those locales, we can create habitat in a variety of urban and rural environments. Parks and other open spaces can be enhanced to ex-

pand the acreage of flowering meadows. Roadsides and powerline corridors cover tens of thousands of acres of land in the Central Valley, stretching across agricultural and urban landscapes; although these are not a substitute for wildlands, they can be turned into valuable habitat for wildlife, providing refuge and connecting remnant habitat patches. In many parts of the Valley, habitat will necessarily be restricted to the field edges, roadsides, and ditch banks, but hedgerows and flowering strips and meadows in these areas will increase the diversity and abundance of pollinators as well as of the predators and parasites of crop pests. Maximizing restoration and management of such linear habitat opportunities will be vital if we want to restore large areas of the Valley.

Seen from the air, the scale of the Central Valley landscape's transformation is readily apparent. Crops push right to the Valley's edges, leaving little room for wildlife. Photograph by Ethan H. / Flickr.

These linear habitats may be particularly important in aiding the dispersal of species as they adapt to climate change. Recent research shows that field borders, hedgerows, and roadsides can serve as corridors, allowing pollinators to move through the landscape whether in search of food or in pursuit of new places to live.

The Xerces Society has a field-tested model for providing habitat in disturbed landscapes. Indeed, our pollinator program actually began in the Central Valley, in Yolo County in 2006, as a pilot project with farmers, the University of California at Berkeley, Audubon California, and the Center for Land-Based Learning. The program has since expanded to all fifty U.S. states and various territories. Our staff members work with farmers to develop whole-farm pollinator conservation and restoration plans, outlining activities such as the planting of native hedgerows and managing tillage, pesticide use, and other farm practices. We have trained more than eighty thousand farmers, gardeners, conservationists, government agency staff, educators, and land managers to create, manage, and protect pollinator habitats.

Since its inception, our pollinator program's work with farmers and the Natural Resources Conservation Service has led to the establishment of more than 420,000 acres of wildflower-rich pollinator habitat across the United States. This includes miles of hedgerows planted in the Central Valley in cooperation with farmers and other partners; hedgerows planted a decade ago have now developed into mature habitats that provide homes for bees, butterflies, birds, and other animals. Recent studies also show that in addition to generalist

The Central Valley's few remaining vernal pools hint at the landscape that John Muir experienced in the late nineteenth century. In spring, the seasonally drying pools are surrounded by goldfields (*Lasthenia*), a member of the aster family, the Compositae noted by Muir. Photograph by the Xerces Society / Matthew Shepherd.

Several years after planting, this hedgerow provides insects with shelter for nesting and season-long bloom for foraging. Photograph by the Xerces Society / Jessa Kay Cruz.

bees, these mature habitat areas support less-common bee species. This work shows that we can increase biodiversity in the landscape through specific restoration projects.

I believe that there are big opportunities to increase habitat conservation in and around crop fields in the Central Valley. Unlike farmers in Iowa and other regions who grow primarily corn and soybeans, farmers in the Central Valley grow a variety of crops that need insects to pollinate them. Whether they raise almonds, sunflowers, or melons, farmers with crops that benefit from insect pollination can help insulate themselves from declining numbers of honey bees by restoring and managing insecticide-free habitat, a kind of insurance policy for when honey bees are in short supply.

The habitat can bring an additional benefit—help with controlling crop pests—thanks to the number and diversity of predators and parasites that it also supports. As a result, even those who grow crops that do not need pollinators, such as grapes, can benefit. Moreover, farmers can get free technical assistance and often can receive cost-share funding to help defray the expense of these habitat plantings. The Xerces Society partners with the NRCS in California to provide training and technical assistance and to help farmers through the process of securing cost-share funding.

The Xerces Society has been at the forefront of finding new ways to incentivize the creation of habitat for pollinators and beneficial insects and to promote good pesticide practices by working with our corporate partners. We assisted Whole Foods Market in developing the Responsibly Grown ("good, better, best") system under which farmers are rewarded for pollina-

Conservation-minded growers can make a difference by providing habitat. This almond orchard in the Central Valley is being managed to support bees and other beneficial insects. Photograph by the Xerces Society / Jessa Kay Cruz.

tor stewardship. We are also rolling out a bee-specific product-rating program this summer. Bee Better Certified will allow farmers and the companies that buy their produce to label their products as Bee Better if they meet requisite standards for habitat management and pesticide stewardship.

Other companies are stepping up to enhance habitat and to limit pesticide use. General Mills is working to improve its supply chain by creating pesticide-free pollinator habitat throughout thousands of acres of its supplier farmlands. The company has already funded large projects in almond orchards and at the Muir Glen tomato-processing plant in the Central Valley; these sites not only provide high-quality habitat but are an influential demonstration of what can be done by farmers. Häagen-Dazs, White Wave, and others are working with Xerces to create habitat on supplier farms. This winter, Häagen-Dazs implemented a project that included nearly seven miles of flowering hedgerows within a single almond farm.

Grazing lands in and around the Valley can be managed with insects in mind, employing conservation plans that provide for the cattle and simultaneously maintain or expand native flowers that benefit a broad array of animals. In the long run, these lands will be better able to withstand drought as well.

Agricultural areas of the Central Valley are key to re-flowering this landscape, but if we are to be truly successful we need to work beyond farms. Parks, open-space areas, roadsides, powerline corridors, and land in the care of local, state, and federal agencies can all be managed in such a way as to benefit pollinators and foster biodiversity. A neat

thing about invertebrate conservation is that it can be carried out at a broad range of scales, and even homeowners can be part of the picture. To truly re-flower the Valley we will need an "all hands on deck" approach.

At-risk bumble bees call the Central Valley home, as do many other habitat-specialist ground-nesting bees. Habitat improvements in the Valley will help increase their chances for survival just as it will for other rare and at-risk species. Scientists and agencies have identified the Central Valley as a vital component for the recovery of the western population of the monarch butterfly. Hundreds of thousands of monarchs overwinter along the California coast but cross the Valley as they disperse to the Intermountain West to breed and then again as they migrate back to overwintering sites in the fall. Providing habitat can allow this iconic species to safely traverse this heavily used landscape and once again to breed in large numbers in the Valley.

It may well be humans who will benefit the most from transforming the Valley because the value of these animals to pollination and pest control is a direct benefit to the farmers who grow our food and an indirect one to all of us who eat it. Beyond the value for bees and butterflies, these restored and better-maintained landscapes can provide a host of other benefits: improving water quality by limiting runoff in ditches and streams, decreasing dependence on water quantity with native plants that use less water than most nonnatives, protecting soil from erosion, building soils, trapping carbon, and providing places where humans can experience nature.

Will this effort be easy? No. Can it be done? Yes, I believe it can. California is a leader in the realms of climate change mitigation, clean energy, pollution reduction, and other important environmental issues. We can use this leadership to push for real change.

We need state and federal agencies as partners in this effort, as many of the last intact landscapes in the Valley are under their management. But ultimately it is about what each of us can contribute. Homeowners can plant a pollinator or butterfly garden, farmers can improve habitat in and around their fields, managers of roadside and powerline rights-of-way can change how they mow or spray, and municipalities can step up to ensure that our open spaces are oases for animals. We can all limit the use of toxic pesticides. Together, we can accomplish this momentous task.

Insects are resilient, but in the face of large-scale habitat loss they need a helping hand. Providing habitat for them is often relatively easy compared to doing so for other animals, and habitat for insects underpins the food chain that supports vertebrate species. The landscape of Muir's time is lost forever, but we could still see rivers of flowers flowing along roadsides, ditches, and streams, and through orchards and farms, allowing for biodiversity to thrive across the landscape. By focusing on the small animals that help drive ecosystems we can help them re-weave the fabric of life in the Central Valley.

Scott Hoffman Black is the executive director of the Xerces Society. He has been engaged with habitat restoration for more than three decades.

Post-Brexit Britain Grapples with the EU Moratorium on Neonicotinoids

Dave Goulson

In 2013, the European Commission acted to protect bees by restricting the use of three neonicotinoid insecticides within the twenty-eight countries of the European Union. This wasn't a complete ban on their use—it covered seed treatments only of certain crops that are attractive to bees, such as oilseed rape, and spring-sown cereals—and was to apply for an initial period of just two years, after which the evidence was to be reviewed and the decision would be reconsidered. Nevertheless, this was a controversial act, hailed as a breakthrough by environmental and consumer advocates, and condemned as a backward step by the agricultural and chemical industries.

The Commission's action came in response to a review by the European Food Safety Authority of the scientific evidence for impacts on bees from the use of three neonicotinoids: clothianidin, imidacloprid, and thiamethoxam. That review, published in January 2013, concluded that the three neonicotinoids posed "an unacceptable risk to bees." The Commission proposed a two-year moratorium, which was put to a vote by the EU's member states in a rather complicated and drawn out decision-making process wherein votes were weighted according to the population size of each country rather than a simple one-country-one-vote process. Notwithstanding extensive lobbying on the issue, the ban won a slender majority of the vote. Because of the weighted voting, however, the result was considered inconclusive, and authority for making the decision fell to the Commission, which then imposed the moratorium. The restrictions took effect at the beginning of the following December.

The British government was opposed to the ban—and Britain, as the third most populous country in the EU, carried considerable clout during this process—but once the moratorium had been adopted, Britain had no choice but to comply. Because the ban is only partial, though, neonics remain very widely used on winter-sown cereals and other crops, so total usage continues to rise year over year, according to statistics from the British government's Department of Farming and Rural Affairs.

The two-year period of the ban expired in late 2015, and the evidence for and against its continuation has been under review since then. It is unclear whether or not the European Union will continue the restrictions on neonics, but in the aftermath of last year's Brexit referendum the EU's stance no longer matters as much for Britain. The real question now for the country is whether it will retain the moratorium once having fully withdrawn from the European Union, in about two more years' time.

There is considerable pressure in Britain to overturn the ban. Britain's

National Farmers Union has actively campaigned against the moratorium and has twice submitted an emergency application to allow the banned insecticides to be used on oilseed rape—known in North America as canola—a major crop that, when in bloom, is a significant foraging resource for the country's bees. In each case, the NFU argued that the seed treatments were required to avoid heavy crop losses, claiming that a drop in yield of up to 30 percent could be expected if the pesticides were not used. British government statistics, by contrast, showed that there was no such drop in yield, and that yields of other crops affected by the moratorium, including corn and sunflowers, have remained high across Europe.

Despite the apparent lack of losses attributable to the EU moratorium, the efforts to overturn it continue. In autumn of last year, the Society of Chemical Industry held a meeting in London to discuss the question, "Are neonicotinoids killing bees?" This meeting appeared to be a rather one-sided affair: a lot of lobbyists from the agrochemical industry and a hand-picked selection of scientists consisting overwhelmingly of those known to have pro-pesticide leanings or to receive funding from the industry. The meeting's conclusions are represented by comments made by two attendees, a university researcher and an industry representative, on BBC Radio 4's *Farming Today*.

The researcher's comments can be paraphrased as: "It is all complicated and confusing, and we can't really be sure what harms bees. The moratorium on neonicotinoid use on flowering crops

Oilseed rape has long been a point of contention in rural England, its bright color disrupting the bucolic landscape. It is once again at the center of a debate, this time over the impacts of insecticide use on bees. Photograph by Mark Robinson / Flickr.

is forcing farmers to use older, nastier chemicals, about which we know little. That could be worse for bees than using neonics." The industry representative was more emphatic, stating categorically that in real-world situations neonics do not harm bees. He pointed to a study published in 2015 by Maj Rundlöf (of Sweden's Lund University) and colleagues. In the largest field trial yet performed for the purpose of examining the effects of neonics on bees, they found no effect on honey bees when their hives were situated next to a treated oilseed rape crop for a year.

Anyone listening to this would be inclined to think that the scientific evidence against neonics is far from clear, and that the moratorium might in fact be doing more harm than good. Of course, this is exactly what the meeting was intended to achieve. The pesticide industry makes billions of dollars every year from these chemicals, and spreading doubt and confusion is an effective tactic to prevent policy makers from taking further action, and to encourage the post-Brexit British government to abandon the EU moratorium altogether.

So let's look at what we actually do know with certainty about neonics.

These are very widely used neurotoxins, applied to many arable, horticultural, and ornamental crops. They have high persistence, so they last for years in soil, and because they are water soluble they are now routinely found in streams and ponds around the world. They are also found in the pollen and nectar of treated crops, as well as in the pollen and nectar of wildflowers growing nearby.

When we place colonies of honey bees or bumble bees in farmland, the pollen and nectar stores that they gather often contain a cocktail of several neonics (and a bunch of other pesticides, mainly fungicides). Concentrations of neonics in their food typically range from one to as much as ten parts per billion (ppb), sometimes more. If we dose honey bees or bumble bees in the laboratory or in flight cages with food spiked with these same concentrations of neonics (i.e., between one and ten ppb), we get the following range of effects: reduced longevity, diminished immune response, impaired learning, reduced egg laying by queens, and reduced fertility in males. Bumble bee colonies exposed to field-realistic doses or exposed to treated crops in a field setting perform very poorly, grow slowly, and produce few queens. Solitary bees also perform poorly when near treated crops: fewer wild bees are found on the crop itself, and mason bees fail entirely to nest in such areas.

Not every study finds the same effects and a few have found none at all. The variety in research results is presumably due to differences in methods, the particular neonic used and its dosage, the age and health of the bees, the bee species studied, and other such factors. It isn't simple, but the overwhelming evidence is that neonics do harm bees at field-realistic doses.

When honey bee hives are exposed to treated crops, the deleterious effects on individual bees described above do not seem to translate into significant harm to the hive, at least inside a single year. This conclusion is based on the research of Maj Rundlöf et al. mentioned above, as well as on a couple of studies either performed by or funded by the agrochemical industry itself, which

There is little doubt that neonicotinoid use is harming bumble bees. When exposed to treated crops, their colonies grow slowly and produce fewer queens. Photograph by Dean Morley / Flickr.

should probably be viewed with a bit of skepticism. Even if we take such studies at face value, they do not rule out the possibility that exposure to neonics might contribute to colony loss in the longer term—for example, by reducing queen longevity, or fecundity, or both—but it does seem that there is no dramatic and immediate effect on honey bee colonies in the way that there is on bumble bees and solitary bees.

It is true that it has not been proven beyond doubt that neonics cause honey bee colonies to die, although it would seem highly likely that having their food laced with neurotoxins at doses that are known to leave individual bees dazed, confused, susceptible to disease, and suffering other sublethal effects isn't helping honey bee hives cope with their many other problems. Perhaps the very large size of honey bee colonies buffers them against the impacts of pesticides, at least in the short term.

For bumble bees, on the other hand, the case that they are harmed by neonics is iron-clad. There are dozens of studies from laboratory to full field experiments that provide a convincing and coherent body of evidence.

To return to the comments of the meeting attendees, the industry representative was being deliberately disingenuous. In referring to the Swedish study as demonstrating that neonics do not harm honey bees, he was relying on the audience being ignorant of the fact that there are many other types of bee—and of the fact, which he thought better not to mention, that this very study showed devastating effects on bumble bees and solitary bees. Bumble bees are enormously important pollinators of crops and wildflowers, as are some wild

Trees and hedgerows are an essential feature of Britain's countryside, supporting a wide range of plants and animals. Pesticide use in surrounding fields has a negative impact on wildlife. Photograph by Henry Hemming / Flickr.

solitary bees; in Britain, honey bees contribute no more than perhaps 30 percent of crop pollination, the rest coming from wild insects.

The researcher's claim that it is all complicated and confusing is misleading at best. It is pretty clear to anyone who is even a little familiar with the scientific literature on the declines in wild bee populations and the losses of honey bee colonies that these phenomena are due to multiple causes, including the loss of flower-rich habitat, the spread of parasites and diseases, and exposure to pesticides. If we want to address bee declines then we need to tackle all of these issues, and we need to do so with urgency, rather than standing around arguing about which is worse, or saying that we need to do more research before we take any action.

The argument that the neonicotinoid ban has forced farmers to use older, nastier chemicals that we know little about is an interesting one, and is a notion I have heard trotted out many times by the agrochemical industry. The neonic ban led British farmers to increase spraying with pyrethroids, on young crops of oilseed rape in September. These are older chemicals, which have been in use for decades and are very well studied. If they were sprayed onto a crop at the time of flowering they would kill lots of bees. Spraying them in September onto seedling oilseed rape, however, is likely to have minimal impacts on bees: most wild bees are gone by then, and honey bees have no reason to be visiting the crop. Pyrethroids have very low persistence compared to neonics, so they will not hang around until the spring when the crop flowers. Of course, it would be better still if farmers investigated nonchemical means of managing their crop pests, adopting an integrated pest management approach whenever possible, but that is for another day.

Despite what the agrochemical industry and its supporters claim, the evidence linking neonics to declining bee populations is overwhelming. But industry will continue to say that black is white, that neonics don't harm bees, just as some continue to deny the existence of climate change because it suits their financial interests. As the American author Upton Sinclair once said, "It is difficult to get a man to understand something when his salary depends on him not understanding it."

We urgently need to put pressure on our politicians to ensure that they ignore such prevarications and take proper steps to prevent the wholesale pollution of our countryside with persistent neurotoxins. More broadly, we need to find ways to reduce the grip of the chemical manufacturers on the way we grow food. Regardless of Brexit—and indeed regardless of whether one likes or does not like Brexit—it is crucial for Britain to continue the moratorium on neonicotinoid use that was initially put in place by the European Commission. If we don't steer away from industrial, chemical farming towards more sustainable methods, we will lose bees—and much more of our wildlife—forever.

Dave Goulson is a professor of biology at the University of Sussex in Britain, where he specializes in the ecology and conservation of bumble bees. He is the author of A Sting in the Tale *and* A Buzz in the Meadow*, and of the recently released* Bee Quest.

This article is adapted from a post on Goulson's blog, http://splash.sussex.ac.uk/blog/for/dg229.

Britain's village greens, which often have flower-rich meadows sheltered from pesticides, can provide valuable habitat for wildlife. Photograph by Mark Schofield / Flickr.

Julie Serences, Xerces Partner in Conservation

Julie Serences describes her introduction to the world of native bees as "humbling." A naturalist and an active member of the Sacramento Audubon Society, Julie became aware of how critical insects were to the health of her garden while working on her own backyard habitat projects. Soon after, she met a bee expert and was astonished at seeing his collection of more than eighty different native bees from the Sacramento area. She was hooked.

In spring 2009, Julie worked with Audubon to set up a native bee workshop featuring local experts and speakers from the Xerces Society. At ease in front of crowds and with a talent for engaging people of all ages—no surprise for a retired schoolteacher—Julie began giving talks to garden clubs and schools. It wasn't long before Xerces, always overwhelmed with requests to speak at outreach events, asked Julie if she might be willing to represent us.

Julie embraced the challenge and went on to give dozens of "Bring Back the Pollinators" talks at a wide range of gatherings and community meetings, sharing our message of pollinator conservation and encouraging the creation of backyard and schoolyard habitats.

Julie moved to San Diego a couple of years ago. In a testament to her impact, people from Sacramento still contact us, saying that "Julie from Xerces" has been recommended, and are greatly disappointed to discover that she has moved.

Faced with the new ecology, new plants, and new bees of southern California, Julie has largely taken a break from pollinator events, instead focusing now on one-to-one outreach.

Some people grab the limelight by charging in and making a lot of noise and fuss. Others quietly work away on their chosen area of concern, gradually building a reputation that carries them forward. Julie Serences is very definitely in the second category. Through her knowledge, dedication, and enthusiasm, she inspires people into action, creating a legacy of lasting change.

Photograph by John Serences.

Sandstone Bees

A solitary bee that digs its nest in sand is commonplace, but a bee that excavates in sand*stone* is something that you need to go to some effort to find. Michael Orr, a graduate student at Utah State University, has done just that, expending considerable time and energy to locate and visit dozens of such nesting sites in the rocky deserts of the Four Corners region, where Utah, Colorado, New Mexico, and Arizona meet.

These remarkable bees are in the genus *Anthophora*, collectively known as "digger bees"—and they certainly live up to that name. It appears that they gather water to soften the rock, and then, bit-by-bit, chew out a nest tunnel.

The benefits of their labor come in the form of protection from nest parasites and from predators that can't penetrate the sandstone, and also perhaps in providing refuge from flash floods. The nests are durable enough to allow bee larvae to remain for a few years if necessary, waiting for a good season of bloom in the harsh environment. (For more information, see the USDA article at http://bit.ly/2q3Vfdq.)

Assessing Pollinator Health on British Farms

In Britain, a project of the Worcestershire Wildlife Trust promoting pollinator habitat on farms has become a nationwide model for what can be done. The Trust's grasslands and agriculture officer, Caroline Corsie, has created a "Farm Health Check" to assess pollinator habitat, based on Xerces' "Pollinator Habitat Assessment Guide."

The farm health check outlines bees' basic habitat requirements, and guides users through a series of simple questions to assess and rate a farm. The health check looks at the presence of habitat, diversity of flowers, nesting sites for bees, and farm management practices, including pesticide use. At the end, the user will have a summary that identifies which habitat needs are not being met, and thus where time and effort should be directed to make the farm more hospitable to bees. This is a great resource to assist British farmers with planning pollinator habitat. (A PDF of the farm health check can be downloaded from http://bit.ly/2pyxhmL.)

How Much Prey do Spiders Catch?

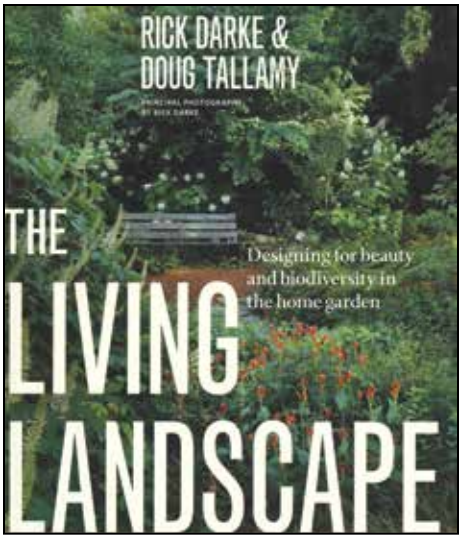
A pair of European researchers have estimated how much prey the world's spiders kill each year. By calculating the biomass of spiders (twenty-five million tons) and from there the amount of prey based on the food needs per unit of body weight, and also by reviewing the literature on prey kills by spiders, Martin Nyffeler, of the University of Basel, and Klaus Birkhofer, of Lund University,

concluded that spiders kill between four and eight hundred million tons of prey annually. Several media outlets reported that this is as much as the meat and vegetables eaten by all the humans on the planet! The study, "An estimated 400–800 million tons of prey are annually killed by the global spider community," was published in the April 2017 issue of *The Science of Nature*. (For more information, visit http://bit.ly/2msUTZq.)

Book Review

Ten thousand. That's how many caterpillars a pair of chickadees may need to gather in a period of less than three weeks to successfully fledge their brood. This kind of abundance year after year is only possible from a landscape of diverse, native plants. In *The Living Landscape: Designing for Beauty and Biodiversity in the Home Garden* (Timber Press, 2016), Rick Darke and Doug Tallamy provide the guidance to help you create just such a garden.

The book is presented as two complementary narratives, with each author drawing from personal experience to enliven his story. Doug explains the science and the ways in which restoring habitat in his own suburban yard informed his research. Rick recounts his years spent working as a landscape designer, and draws upon that experience to present the principles of successful garden design.



Both authors are talented photographers, as this volume beautifully demonstrates. The gardens shown appear to be from the eastern United States—the Mid-Atlantic in particular—but if you live in the western states and don't recognize your landscape or plants, don't despair. The gardening philosophy and techniques presented in this book are relevant to all regions, and the last fifth consists of extensive regional plant lists that include notation of their ecological and landscape uses.

We're sure many of our readers are familiar with Doug Tallamy's groundbreaking book *Bringing Nature Home*, which so clearly explains the value that native plants have for native insects. (We know that it is often paired on gardeners' bookshelves with our own *Attracting Native Pollinators*!) This new volume proceeds to the next logical step, demonstrating how landscape design and respect for nature can be combined to create ecologically sound gardens that meet the needs of both people and wildlife. The inspiration it provides will send you into your own garden to find ways to apply what you just read.

STAFF PROFILE

Sarah Foltz Jordan, Pollinator Conservation Specialist

What got you interested in invertebrates? I grew up as a barefoot kid on a Minnesota fruit farm, climbing trees, sleeping outside, and picking flowers. But it wasn't until college that I got excited about invertebrates, starting with zooplankton. I'll never forget the first time I saw a copepod under the microscope and realized that I'd been swimming in lakes with these tiny one-eyed monsters my whole life!

How did you hear of the Xerces Society? *Wings* magazine. Everywhere I worked after college—from USGS field stations in Hawaii and Utah to graduate school in Wisconsin—this gem of a magazine was lying around, or someone was giving me a back issue.

What made you want to work here? Having seen so many jobs in entomology that were focused on how best to *kill* insects, I was really excited to find a career opportunity that was instead centered on *conserving* invertebrates.

Who's in your family? My husband, Nick, our seven-year-old son, Scion, and our cat, Lumin.

What books are you currently reading? *History of the Ojibway People* by William Warren, *Pilgrim at Tinker Creek* by Annie Dillard, and *When Women Were Birds* by Terry Tempest Williams.

What do you do to relax? Usually something in the garden or the woods. Planting seeds, gathering wild mushrooms, watching insects, picking apples. I also enjoy acro-yoga, painting, board games, and biking with my family.

What's your favorite place to visit? The red rock canyon country around Moab, Utah, will always pull at me. Closer to home, the Boundary Waters Canoe Area in northern Minnesota, and still closer, I'd choose Kathio State Park for its rich forests and unusual, steep terrain.

Who is (or was) your environmental hero? Wendell Berry has certainly been an influence. And also Gene Stratton Porter, author of *Girl of the Limberlost*, a 1902 book about a young moth collector in the swamps and woodlands of central Indiana. Even then, these were rapidly disappearing ecosystems, which Porter loved, documented, and fought to protect from dredging and logging.

Protection for the Rusty Patched Bumble Bee

March 21, 2017, was a historic day for bee conservation. On that date, protection under the Endangered Species Act took effect for the rusty patched bumble bee (*Bombus affinis*), making it the first bee in the continental United States to be federally protected.

This success came about after more than a decade of work by the Xerces Society and our partners: scientists, farmers and land managers, advocates, filmmakers, and citizens, all of whom care about native bees and their plight. The protection was a direct result of the petition for ESA listing filed by the Xerces Society in January 2013.

In March, the rusty patched bumble bee (*Bombus affinis*) was listed under the Endangered Species Act, becoming the first bee in the continental United States to be federally protected. This result was achieved thanks to the contributions of many people, including Clay Bolt, who took this photograph.

The effort to protect the rusty patched bumble bee has been long and arduous, and the task has been helped along by numerous people, including colleagues in the scientific community, our partners at the Natural Resources Defense Council, and staff of the U.S. Fish and Wildlife Service.

The Xerces Society is grateful for the many individuals who participated in citizen science efforts on behalf of the bee, initially via Project Bumble Bee and since 2013 through Bumble Bee Watch. Observations from citizen scientists played a critical role in helping to understand the rusty patched bumble bee's current distribution. Special thanks go to photographer Clay Bolt and filmmaker Neil Losin of Day's Edge Productions, who together produced the award-winning film *A Ghost in the Making*.

Now that the rusty patched bumble bee is listed as an endangered species, the U.S. Fish and Wildlife Service has the authority to develop and implement a recovery plan. That undertaking has the potential to help stabilize populations of this bee and move the species toward a secure future.

The overwhelming scientific and public support for this bumble bee has been incredibly heartening. Thank you to everyone who supported protection for this important pollinator.

Male silvery blue (*Glaucopsyche lygdamus*) nectaring on spring beauty (*Claytonia virginica*), photographed by Bryan E. Reynolds.

Planned Giving: Your Legacy for Invertebrates

A charitable bequest is one of the simplest ways in which you can provide continuing support to the Xerces Society beyond your lifetime. Your gift will have a lasting impact on the conservation of essential invertebrates and will help to preserve these creatures for future generations.

We highly recommend that you discuss your planned giving options with your financial or legal advisor in order to choose a gift that works best for you and your family. If you would like to inform us of your plans, please email us at membership@xerces.org, or write to us at 628 Northeast Broadway, Suite 200, Portland, OR 97232.

Studying Monarch Butterflies in the West

Monarchs, the best-known and most beloved butterflies in North America, face an uncertain future. News of the butterflies' declining numbers and their struggles to successfully traverse the landscape during their annual migrations have generated a great deal of interest. The Xerces Society has been involved with monarch conservation across the butterflies' eastern flyway for decades, and also plays a pivotal role in protecting monarchs in the western United States.

Last fall, the Western Monarch Thanksgiving Count, which Xerces founder Robert Michael Pyle notes is "one of the senior invertebrate conservation undertakings in the country,"

The Xerces Society has launched a new project to map milkweed, the monarch caterpillar's food plant, across the western United States. Photograph by the Xerces Society / Candace Fallon.

marked its twentieth anniversary. The count would not be possible without dedicated regional coordinators—including Mia Monroe, one of its founders, who has organized, trained, and inspired volunteers since 1997.

The count happens over a three-week period centered on Thanksgiving, during which biologists, land managers, and citizen scientists find and count butterflies at monarch overwintering sites. Volunteer participation, which is crucial to the effort's success, continues to grow; over the course of the 2016 Thanksgiving Count more than a hundred volunteers monitored a record 253 overwintering sites.

Just under three hundred thousand monarchs were counted. This was more than the previous year's total, but it is no cause for celebration. The difference is primarily due to a large increase in volunteer effort—which meant that more sites were visited—and in fact monarch counts at major sites were down when compared to recent years. Key sites such as Pismo Beach and Natural Bridges saw lower populations this last year, and all but one of the fifteen sites that have been continuously monitored since the first year of the count had fewer butterflies than in the prior year. The total was a fraction of the 1.2 million monarchs recorded in the late 1990s.

We are still working to learn the reasons for the population decline in the West. Loss of milkweed is the most significant factor contributing to declines in the eastern United States, but we do not know how significant it is on the other side of the continent. Initial mapping efforts by the U.S. Fish and Wildlife Service and the Xerces Society have revealed that extensive milkweed breeding habitat exists throughout most of the West, but there likely have been large losses of this important host plant in such agricultural areas as California's Central Valley.

To help fill gaps in our understanding, the Xerces Society has launched the Western Monarch Milkweed Mapper (www.monarchmilkweedmapper.org), a web-based project to find and map the locations of monarch caterpillars and their milkweed host plants across the western United States.

Anybody—citizen scientists, biologists, researchers—can contribute to the Western Monarch Milkweed Mapper. Milkweed and monarch sightings will be added to the database and interactive map, generating an ever more accurate understanding of the distribution and phenology of these two interlinked species. Offering guides to identify forty-six western milkweed species, the website

also provides an educational resource.

This project is a collaboration between the Xerces Society, the Idaho Department of Fish and Game, and the Washington Department of Fish and Wildlife, with funding from a U.S. Fish and Wildlife Service State Wildlife Grant and the National Fish and Wildlife Foundation. Staff of the U.S. Fish and Wildlife Service Pacific Region helped with initial data collection, and the project has received additional support from private foundations and Xerces members.

Combining Forces to Protect Pollinators

The Xerces Society has joined in a partnership with General Mills and the U.S. Department of Agriculture to support pollinators. General Mills and the USDA's Natural Resources Conservation Service have jointly made a five-year, $4 million financial commitment.

The focus of the partnership is on creating pollinator habitat on working farms and ranches. The funding will support six new Xerces pollinator specialists, who will be managed jointly with the NRCS. This represents a significant expansion of our pollinator team. The new staff will support farmers by working hand-in-hand with NRCS conservation planners to provide individual consultation on habitat restoration and pollinator-friendly farm management practices. They also will help train conservation agency staff in the states where they are based—California, Iowa,

Thanks to a new partnership between General Mills, the USDA's NRCS, and Xerces, half a dozen new pollinator specialists will be working with farmers and agency staff to expand habitat for pollinators. Photograph by the Xerces Society / Matthew Shepherd.

Nebraska, North Dakota, Minnesota, and Maine—and surrounding regions.

Through this partnership we will help to plant more than a hundred thousand acres of pollinator habitat over the next five years on farms across the United States. We thank General Mills and the Natural Resources Conservation Service for their commitment to healthier pollinator populations.

Wings Magazine Celebrates Thirty Years

This issue of *Wings* marks the magazine's thirtieth anniversary as a full-color publication. *Wings* had its first incarnation as a black-and-white photocopied newsletter, from 1974 to 1985. A few years later, Melody Mackey Allen, then the Xerces Society's executive director, set out to bring the publication back to life as a full-fledged magazine. She was aided in this effort by Mary Troychak, the magazine's first editor; and John Laursen, an award-winning book designer, typographer, and editor. The inaugural color issue reached Xerces members in the spring of 1987.

John, who designed *Wings*' format and layout, has continued to work on the magazine to this day—refining the text, designing the pages, and overseeing production of every issue. His influence has been particularly profound in the quality of the photographs, guiding their selection and ensuring the finest reproduction. Although not directly employed by Xerces, John has worked with the organization for longer than any staff member, and his three decades of meticulous attention to *Wings*—which continues to charm and delight—has contributed greatly to our success.

The March for Science

The Xerces Society regularly partners with other organizations and individuals on projects as diverse as tree planting, letter writing, and filmmaking. This spring, Xerces joined an initiative that entailed participation in a different activity: marching on behalf of science.

Held on Earth Day, the March for Science was a celebration of scientists and science, a chance to highlight their importance to our daily lives, and an opportunity to promote evidence-based policy making. The march also allowed Xerces staff members to demonstrate our support and appreciation for the many scientists who have contributed to the Society's work over the decades.

Science is at the heart of who we are at the Xerces Society. The Society was founded by a scientist; in its early years as a volunteer-run organization, Xerces' leadership was largely made up of scientists; the majority of our staff over the years have been and are scientists; we engage with research partners who help to inform the projects we undertake; and we rely on scientific evidence to guide our policies and advocacy. We at the Xerces Society were proud to display our ongoing commitment by being a partner in the March for Science.

Xerces staff members participated in marches in Washington, D.C.; Omaha, Nebraska; Sacramento, California; Sheboygan, Wisconsin; and Portland, Oregon. We also were invited to speak at the marches in Omaha, Sheboygan, and Portland, and we had a booth at the Portland event. Many of our members joined marches in their local area. We thank you for your involvement in this important movement.

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For information about membership and to learn about our conservation programs for native pollinators, endangered species, and aquatic invertebrates, as well as our efforts to reduce the impacts of pesticides, contact us:

THE XERCES SOCIETY FOR INVERTEBRATE CONSERVATION
628 Northeast Broadway, Suite 200, Portland, OR 97232
toll-free 855-232-6639 fax 503-233-6794 www.xerces.org

The striking blue color of this emerging lyric cicada (*Neotibicen lyricen*) will fade as its body hardens and turns darker. Photographed in Oklahoma by Bryan E. Reynolds.

A $35 per year Xerces Society membership includes a subscription to *Wings*.

On the cover: Metallic green sweat bee (*Augochlora pura*) on butterfly milkweed (*Asclepias tuberosa*), photographed in farm habitat by the Xerces Society / Sarah Foltz Jordan.

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