

WINGS

ESSAYS ON INVERTEBRATE CONSERVATION



THE XERCES SOCIETY

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Navigating a Changing World

Scott Black

When I became executive director of the Xerces Society almost twenty years ago, I knew there would be many challenges. A lack of understanding and empathy for insects by land managers, gardeners, and the general public, and a lack of scientific data on most species—even such economically important ones as native bees—were early impediments.

Since then, from small beginnings with just a few staff, we have overcome many hurdles and now have a world-class conservation team. Whether we are working on endangered mussels with our dedicated conservation biologists, helping farmers protect and restore habitat across North America with the large-

est pollinator conservation program on the planet, pushing for pesticide reductions with our advocacy staff, or engaging communities with skilled communicators, our goal remains the same—protecting the life that sustains us.

What I did not anticipate all those years ago was the challenge of managing a nonprofit during a pandemic. The coronavirus has changed the lives of many millions of people, and my heart goes out to everyone who has been affected by bereavement, illness, isolation, or loss of income.

We have been very lucky at Xerces, with no severe illness among staff, but we've had our work cut out for us: figur-



Insects and other invertebrates remain the focus of our work, but due to the coronavirus we have had to make changes to the way we operate. Male leafcutter bee (*Megachile parallela*), photographed by Bryan E. Reynolds.

ing out how to continue our important mission as our entire society is upended by the coronavirus. We took swift action in March and shifted everyone to home offices, ensuring they had everything needed to be able to shelter at home to decrease the risk to themselves, their loved ones, and their community. We then had to work out how we could continue to deliver our conservation work and reach people with information that would help them protect invertebrates.

For decades, a central component of the work of Xerces staff has been to go out to meet people where they live and work, building trust and collaboration. This approach has consistently produced great success—over the years we’ve reached more than a hundred thousand people through trainings and worked with farmers and land managers to protect and restore more than two and a half million acres of habitat for invertebrates. Now, though, it was clear that none of this was possible, and we had to cancel dozens of workshops, farm walks, and field visits in March, April, and May alone. Unable to meet in person, we had to retool our approach.

Our task was to find new ways to connect from afar, in order both to collaborate among staff and to reach out to provide people with the information and technical assistance they need. I am very proud of how quickly Xerces staff took on this enormous task and created great content for our now-distant audiences. Within a few weeks, we launched a webinar series. Our first webinars in April addressed how pesticides can harm pollinators and what can be done to eliminate or at least minimize pesticide use. May’s series, “Discovering the Insects Around You,” introduced people

to fireflies, bumble bees, tickle bees, and ways to observe nature.

Throughout the summer we will present webinars focused on gardens, including helping beneficial insects, selecting plants for butterflies, providing for pollinators, and more. We are also developing online trainings for farmers and community scientists. Our initial webinars have been a huge success, with each attended by hundreds of people, and recordings are added to our YouTube channel so they can continue to be viewed. We’ve expanded this effort by adding new resources to our website, and we’re also rethinking ways for our e-newsletters and social media to provide complementary channels for sharing information and engaging our supporters.

Our core programs remain strong, and we know that our work is as relevant today as it has ever been. We will return to face-to-face meetings and public events when conditions permit, but throughout this difficult period and beyond we will continue to use applied research, technical expertise, outreach and education, and advocacy to pursue our central mission as strenuously as we always have, protecting the natural world through the conservation of invertebrates and their habitats. Across the United States and Canada, we are working with farmers to protect and restore habitat, with communities to reduce pesticide use, with cities and college campuses to protect pollinators through Bee City USA, and with land managers to protect some of the most imperiled animals on the planet.

We are grateful for your ongoing involvement with our work—and for your steadfast support.

Nature-Based Solutions:

A Win for Both Biodiversity and the Climate

Scott Black

In 1995, I had the considerable good fortune to participate in developing a search strategy for the Uncompahgre fritillary (*Boloria acrocneuma*), a butterfly that lives only in the San Juan Mountains of southern Colorado. That summer I hiked hundreds of miles in some of the world's most beautiful alpine habitats to reach the places where the fritillary lived, north-facing slopes above twelve thousand feet (3,650 meters). At those high altitudes the fritillary

caterpillars' sole host plant—the aptly named snow willow—is kept palatable by the moisture from snow patches that melt throughout the summer. In addition to being a great job, this was my first real look at a species that was being impacted by what we then called global warming.

As far as I know, the Uncompahgre fritillary was the first species to be protected under the U.S. Endangered Species Act for which climate change was



The San Juan Mountains in Colorado include dozens of peaks higher than twelve thousand feet (3,650 meters), which support high-altitude habitats and species that are now threatened by climate change. Photograph by the Bureau of Land Management.



The Uncompahgre fritillary (*Boloria acrocnema*) lives in areas where there is year-round snow to sustain the host plant that its caterpillars eat. Photograph by the Xerces Society / Scott Black.

mentioned as being a factor in its endangerment (although it was referred to in the listing documents as “adverse climatic conditions”).

It makes sense, of course, that a species that lives only where snow persists year-round would be impacted by climate change. What I did not realize at the time was that over the next quarter of a century the climate crisis would become one of the primary driving forces behind species decline everywhere. Now it is not just high-mountain endemics that are impacted, but ultimately all living organisms: species in prairies and meadows, species in our rivers and streams, species that live with us in cities and towns. The loss of biodiversity is being accelerated by changes in climate, and we must act now if we hope to save many important species—including humans—from calamity.

Of course, climate change is not the only threat, and we still need to focus on protecting and restoring habitat, elimi-

nating (or at least minimizing) pesticide use, better managing wildlife diseases, and reducing the light pollution that is disruptive for nocturnal species. Even if, however, we were able to succeed at all of that and yet were to ignore climate change, we would be solving only part of the problem.

A modeling study that looked at distributions of different invertebrates under various climate-change scenarios helps illustrate the importance of tackling climate as part of an invertebrate-conservation agenda. With warming of 1.5°C above pre-industrial levels, 6 percent of invertebrates are estimated to lose at least 50 percent of their ranges; this increases to 18 percent of invertebrates with 2°C of warming and 49 percent of invertebrates with 3.2°C. *The threat is unmistakable: if we do not address climate change, nearly half of all invertebrates could lose half of their ranges.* This would not be bad just for the invertebrates, it would be catastrophic for the

plants that depend on them for pollination, as well as for those birds, fish, and other animals that rely on insects and other invertebrates as food.

So how do we address this issue? First, it is imperative that we act now. Scientists have stressed that we have a limited window of opportunity—likely no more than a few decades—to deal with the climate crisis. Fortunately, there is much we can do, even individually, to limit carbon outputs, a vital part of any solution. Cut back on fossil fuel use by driving and flying less, and try to include as much renewable energy in heating and lighting buildings as possible. (Many utilities have programs through which you can purchase renewable energy.) Food choices are also important. Minimizing animal products, buying organic food (which often

has a lower carbon footprint because no synthetic fertilizers and pesticides were used), choosing local sources to reduce long-distance shipping, and avoiding food waste are all important steps. Individuals, of course, cannot do it all. We need to compel real government action by advocating for strong policies and electing people who will push for sustained climate efforts at all levels.

Beyond lowering your carbon footprint, there is a lot that you can do at your home, around your farm, or in your local park or natural area. Nature-based climate solutions involve actions that protect and enhance nature to help ecosystems and a broad diversity of creatures adapt to a changing climate. These solutions also help to mitigate climate change by increasing the capture and long-term storage of carbon in



Many farmers are either caring for or creating habitat features such as hedgerows to support wildlife on their land. Such plantings can also play a role in mitigating the impacts of climate change. Photograph by the Xerces Society / Jessa Kay Cruz.

plants and in the soil. They can range from simply protecting as much of the natural landscape as possible to restoring and enhancing ecosystems such as forests, but also on farms, along roadsides, and in towns and cities. Trees are an essential part of this solution, but so are native prairie and meadow areas, which are also important for carbon capture and which support biodiversity that is found nowhere else. The benefits of implementing nature-based climate solutions are significant. In addition to supporting wildlife, recent research suggests that natural climate solutions can account for 30 percent of the carbon sequestration needed to limit warming to 2°C by the end of the century.

The great thing about these nature-based solutions is that they can be undertaken anywhere by anyone. Of course, the protection and restoration

of larger landscapes is going to have a big impact, but even making your yard a haven for wildlife will contribute. By using climate-smart native plants, eliminating pesticides, and providing nest sites for bees and host plants for butterflies you can have a very positive effect. And if you work with neighbors or your local park you can create even larger benefits.

Wildlife corridors are an important feature of a nature-based solution. In the face of a changing climate, insects need to move across the landscape to find new nesting and food resources, and there is already evidence that butterflies are shifting ranges in response to climate change. Linear habitats, such as field borders, hedgerows, tree-lined roadways, and green lanes, can act as corridors for pollinators, and thus may be particularly valuable in aiding disper-



Wildlife can live side by side with dense urban development, meaning that even small city plots can provide valuable habitat for invertebrates and other creatures. Photograph by Matthew Shepherd.



Dragonflies are among the many types of wildlife that benefit from habitat restoration along creeks and rivers. Widow skimmer (*Libellula luctuosa*), photographed by Bryan E. Reynolds.

sal. A recent study by the University of Salzburg's Jan Christian Habel and colleagues found that when corridors contain high-quality habitat they can be beneficial for specialist butterflies, and the study also suggested that butterflies preferred such corridors to surrounding lands of lower quality. And it is not just terrestrial insects that benefit from such habitat; scientists at the University of California at Santa Cruz found that restoring riparian corridors improves conditions for a variety of aquatic invertebrates, including stoneflies, mayflies, and caddisflies, three significant insect groups that live in streams.

This too is something in which everyone can do their part. Linking habitat areas by working with neighbors and your local or state transportation departments to add habitat along roadways brings the benefits of larger scale, and helps make it possible for species to move from one place to another as the climate changes.

Xerces recently produced a series of guides to climate-smart habitat restoration and management in cities and towns, roadsides, natural areas, and farms. Although these fact sheets were written for California and some content is specific for that state, the strategies they describe can be implemented anywhere. We also have plant guides and planting resources for the United States and Canada that can help you make your garden, park, farm, or roadside a haven for insects, and thus part of the climate solution we need.

The added benefit of these nature-based strategies is that you will immediately make a difference for local biodiversity, benefiting fireflies, bees, butterflies, birds, and so much more. There is a body of evidence that the more biodiverse a system is, the better it will handle changes in climate, so this approach offers a win-win. Even aquatic species will benefit, thanks both to there being fewer impervious surfaces and



Formal landscaping around businesses and other developments can be part of the solution, as long as proper consideration is given to selecting appropriate plants. Photograph by Matthew Shepherd.

to a reduction in pesticides and other toxic pollutants entering local creeks and ponds. The science is clear: climate change and the loss of biodiversity are interlinked, and coupling efforts at climate mitigation with ecosystem-based approaches is essential. It is impossible to address the loss of biodiversity without addressing climate change, but equally impossible to tackle the impacts of climate change without working to protect and enhance biodiversity.

Xerces is committed to protecting invertebrate diversity from all threats, including climate change. We are working to ensure that our species-protection efforts and our restoration and management guidance take into account future climate scenarios, so that we can implement long-term solutions that enhance biodiversity. Xerces is also doing our

part by lowering our own organizational carbon footprint. By endeavoring to understand our carbon output, getting rid of non-essential plane and car travel, and serving only plant-based foods at events going forward, Xerces hopes to set an example for other organizations and businesses. If we all work together, I believe we can make a difference by striving to maintain biodiversity as we address the threat of a changing climate.

Scott Black is executive director of the Xerces Society. He serves on the science advisory committee of the Urban Draw-down Initiative, which works to accelerate the implementation of carbon-removal strategies that simultaneously improve the social, economic, and environmental resilience of local communities.

Australia's Green Carpenter Bee on the Brink

Matt Kelly

The impact of the recent Australian wildfires has been devastating and terrifying. The scale is almost incomprehensible: the megafire that burned across the country's most populous states of New South Wales and Victoria engulfed approximately twenty-three hundred square miles. And that was just one of the 135 bushfires in southeastern Australia that claimed more than two dozen human lives, ruined nearly three thousand homes, and is thought to have killed roughly one billion animals. Al-

though we do not know the full impact that these infernos had on insects and other invertebrates, such wildfires pose a very real danger to the country's immensely diverse insect populations. One species of native bee might now be teetering on the brink of extinction as a result.

The metallic green carpenter bee (*Xylocopa aerata*) is the largest native bee in southern Australia, measuring almost an inch long. It's generally considered a solitary bee—although a mother may



In late 2019, areas of Kangaroo Island vital for the survival of the metallic green carpenter bee were consumed by massive wildfires. Photograph by robdownunder / Flickr.

share a nest with her daughters—with very specialized nesting needs: trunks of dead banksia (*Banksia*) and stalks of dead grass trees (*Xanthorrhoea*), in which the female chews out her nesting tunnel, using the resulting “sawdust” to create partitions that separate the brood cells. The green carpenter bee is one of a relatively small number of bees that can buzz pollinate—other Australian species that can do this include the teddy bear and blue-banded bees (*Ameigilla*)—making it an essential link in the reproduction of native plants, including guinea flower, velvet bush, and fringe, chocolate, and flax lilies, that depend entirely on buzz pollination for reproduction. And because it is a relatively large bee, it visits many different plants in the course of daily foraging.

Land clearing and previous large bushfires over the past century have already caused local extinction of this

species in areas throughout the country. The metallic green carpenter bee was once widely distributed from New South Wales to Kangaroo Island. It is now found only on the eastern flanks of the Great Dividing Range near Sydney in New South Wales, and on the western part of Kangaroo Island.

Australian researchers and volunteers have been working for years to reverse this trend and rehabilitate the species. Banksia, the green carpenter bee’s preferred nesting material, does not survive fire and requires more than thirty years to grow to the right conditions for the bees to use as home. These researchers, led by Dr. Remko Leijds, of the South Australian Museum, and Dr. Katja Hogendoorn, of the University of Adelaide, have been installing artificial nesting stalks for the bee on Kangaroo Island.

At the time that the recent wildfires



The common fringe lily (*Thysanotus tuberosus*) requires buzz pollination. The green carpenter bee is one of a limited number of species that can do this. Photograph by David Lochlin / Flickr.



This male green carpenter bee (*Xylocopa aerata*) was photographed on Kangaroo Island before the 2019 wildfires consumed its habitat. Photograph by Remko Leijs.

started in December 2019, the team had established 440 nesting stalks at twelve different locations on the island; 160 of those stalks were occupied with nests containing pupae. Unfortunately, nearly all of those areas burned. In the other place where this bee is known to live, on the east coast of New South Wales, nearly 80 percent of the habitat has been destroyed by fire. So, while the wildfires aren't solely to blame for the plight of the green carpenter bee, they might ultimately be the event that pushes this bee over the edge to extinction.

Is this what it's like to lose a species in real time in the Anthropocene Era?

Estimates of global extinction rates are discussed with much gravity these days. The Millennium Ecosystem Assessment indicates that we are losing twenty-four species a day. A hundred and sixty species a week. Eighty-seven hundred species a year. We have to be a bit careful when using such numbers because they are, after all, estimates—

our best educated attempts to put some certainty around an otherwise uncertain situation. But this quantification of extinction is far more than just an academic pursuit. It can and should serve as the standard by which we judge our success or failure at protecting the biodiversity of our world.

Moreover, if we zoom in a bit in terms of both species and geography, there are some things we can say with great confidence. In North America, for example, where more than a quarter of bumble bee species are at risk, five of them—rusty patched, yellow-banded, Crotch's, Suckley cuckoo, and western—are poised to slip quietly into the evolutionary night unless we act. Franklin's bumble bee may already have disappeared, and it would have done so unnoticed except for the tireless work of the late Dr. Robbin Thorp.

But in these cases we have been fortunate in one particular way: the decline has been relatively gradual on a human



The carpenter bees select dead trunks of banksia (*Banksia*), shown here, and grass trees (*Xanthorrhoea*), in both of which they chew out nest tunnels. Last winter's fires burned the trees and the nests they contained. Photograph by Dushan Hanuska / Flickr.

time scale. There is time to notice, time to act. The rusty patched bumble bee is protected under the federal Endangered Species Act because of Xerces' efforts. Xerces also worked with conservation partners to petition for four other bumble bee species—Crotch's, Franklin's, western, and Suckley cuckoo—to be added to California's endangered list, with follow-up legal action to ensure that it happens. Programs like Bee Better Certified have been created to drive real change among farmers and land managers. Countless community science programs engage the public and inspire action at the local level.

But Australia's metallic green carpenter bee shows us another possibility for how extinction can happen: suddenly, jarringly, and catastrophically. The bee's gradual population decline and range contraction put it in a precarious position. Now a single cataclysmic event, one from the deepest nightmares of anthropogenic climate change—a wall of uncontrollable fire walking across the landscape—might finish it off completely. And there's nothing we can do about it.

If this makes you sad, that's a good thing. It means you have a heart and that you care. But you can also find

strength here. The plight of the green carpenter bee has given us a warning. It has shown us why our own actions to protect species—to increase habitat and range, to decrease the number of persistent threats, to value life in all its forms—are so important. Sudden and catastrophic events will become more likely in our near future. We cannot allow bees or butterflies or fireflies or freshwater mussels or any of the vast number of invertebrate species to be boxed into a similar geographic and reproductive corner.

Now that the fires have passed, Drs. Leijts and Hogendoorn and their team of researchers are literally sifting through the ashes to determine what has happened to the green carpenter bee. Recently, in five days of searching, they found twelve nests—a good sign, although previously this number of nests would be found in an hour. The carpenter bees are hanging on, but in very small numbers. The team will return in July to do further surveys and to place fresh artificial nesting stalks in both burned and unburned areas. One hopeful fact is that grass trees flower profusely after fire, as long as the fire has not burned too hot. The grass-tree stalks become available as nesting sites after a couple of years and remain usable for up to six years before collapsing. But, while the landscape recovers, it's the artificial stalks that will guarantee consistent places for the green carpenter bee to nest. These conservation efforts will continue as long as the bee still survives.

The plight of the green carpenter bee and the potential for its extinction are certainly the results of human action. But it is also human action that will change this. It is the work of human

hands that can absolutely preserve the wonderful diversity of species in our world and prevent such terrible losses from happening.

Matt Kelly is an independent journalist. He is the creator, host, and editor of The Bee Report podcast, newsletter, and website, a news site dedicated to helping bee experts, community scientists, and the bee-curious stay connected to the wide world of bees. Matt is also working on a documentary film about the bees of Grand Staircase-Escalante National Monument.



Artificial nesting stalks had been placed on Kangaroo Island and were occupied by carpenter bees before the fires. New stalks will be erected in burned areas, giving hope that the surviving carpenter bees will find them and be able to reproduce successfully. Photograph by Remko Leijts.

Mitigating the Effects of Climate Change On Grassland Butterflies

Angela Laws

Declining biodiversity has been making its way into the news more and more as researchers continue to record losses in plant and animal populations. Insects are no exception, and several recent studies that use long-term data-sets show a marked reduction in insect abundance. For example, observations in Germany over a twenty-seven-year period found a 75 percent decrease in the biomass of flying insects; similar changes have been recorded for moths

in Great Britain. Where I live, in California's Central Valley, thirty-five years of survey data also show a drop in the richness and abundance of butterfly species. A recent paper by Matt Forister, of the University of Nevada, Reno, and Xerces Society staff showed that there is substantial evidence of diminishing diversity, abundance, and biomass across multiple continents. A variety of factors contributes to these insect declines, including the loss of habitat, pesticides,



The painted lady (*Vanessa cardui*) is found almost everywhere. Although its caterpillars prefer thistles, they will eat a huge range of plants from lupines to mallow—and, away from grasslands, even potatoes. Photograph by Bryan E. Reynolds.



The variegated fritillary (*Euptoieta claudia*) may be found throughout the United States (except for the Pacific Northwest) and in a variety of open sunny habitats, including meadows, prairies, and roadsides. It can have as many as four generations in a year. Photograph by Bryan E. Reynolds.

invasive species, and, increasingly, climate change.

The United States is home to approximately eight hundred species of butterflies. These lovely insects can be found in a variety of habitats, from deserts to grasslands to forests, from ocean beaches to mountain tops. The caterpillars usually feed on leaves and other plant parts—the exception being the harvester (*Feniseca tarquinius*), whose caterpillars are carnivorous and eat aphids—while adults feed primarily on nectar, but may also find nourishment on rotting fruit, sap, honeydew, or dung.

Climate change affects butterflies in a variety of ways. While it is possible that some species may benefit, many more will be negatively impacted. The distribution of species is likely to change as butterflies move to follow optimal conditions. Shifts of several butterfly

species have already been observed, often with a shrinking of the southern portion of their ranges. Phenology, or the timing of biological events, can also vary as the climate changes. One concern is that the life cycles of butterflies and their host plants can become misaligned, with plants growing earlier in the season, leaving caterpillars with little to eat. Other changes to plant communities may also have an effect on butterfly populations; increases in drought frequency and severity, for instance, will reduce the amount of nectar available to adult butterflies.

In order to know how to buffer the negative effects of climate change on butterflies and other insects, we need to be able to predict which species might be most impacted. Specialists are among the ones most likely to be vulnerable. A specialist butterfly is defined by what



Species-diverse, flower-rich grasslands are a precious but disappearing asset. More than 99 percent of grasslands have been lost in some areas. Maintaining the remaining grasslands and creating new connections between isolated sites will help grassland butterflies adapt to changing environmental conditions. Photograph by Aaron Carlson / Flickr.

its caterpillars eat. While an adult will drink nectar from a variety of plants, the caterpillars may feed on only a small number of species. Some caterpillars feed on just a single species of host plant; others are slightly less selective, choosing plants from a single genus or family. Either way, such specialization may make these species particularly likely to suffer as a result of climate-change-caused reductions in the abundance of their host plants.

Also highly vulnerable are species that are already under stress from habitat loss, say, or pesticide use, since climate change can interact with such

stressors in a way that magnifies their impact. For example, exposure to a particular pesticide may not be fatal for a butterfly, but, combined with stress from a heat wave or drought, the exposure may become lethal. This is potentially a problem for a wide range of insects, but, for species that are already declining, climate change is highly likely to put them at greater risk.

An important way to protect butterflies—whether specialist or generalist, declining or abundant—from the negative consequences of climate change is to increase habitat availability and connectivity. Larger patches of

habitat can support larger populations, which are generally less prone to extinction than smaller ones. Creating greater connectivity between areas of habitat provides a number of benefits: it allows for larger populations and it enables species to shift their distributions to places with more favorable conditions. It also increases gene flow, potentially boosting the degree of genetic variation in a population and increasing the likelihood that a species will be able to adapt to a warmer climate.

While butterflies are often associated with flowers or shrubs, there are many butterfly species whose caterpillars feed on grasses, sedges, and rushes. Many of these species are skippers (family Hesperiiidae), and these come primarily from two subfamilies—the grass skip-

pers (Hesperiinae) and the skipperlings (Heteropterinae)—although there are several more subfamilies with a few species in each. Skippers and skipperlings are often orange, brown, or grey in color, and tend to have prominent eyes, stout and relatively hairy bodies, and short antennae. Butterflies in the brush-foot subfamily Satyrinae, which includes the satyrs and wood nymphs, also tend to use grasses and grass-like plants as caterpillar hosts, and, although larger than skippers, these butterflies are also usually brown. Because most of these grass-specialist butterflies are small, nondescript, and easily overlooked, there is much less known about their natural history than about that of their flashier relatives. For some of these species, not even the native host plants are known.



The life of the red satyr (*Megisto rubricata*) is closely tied to grasses. Its caterpillars eat the native St. Augustine grass (*Stenotaphrum secundatum*). Photograph by Bryan E. Reynolds.

An illustration of how little is known about a seemingly well-known butterfly comes from Xerces' work on the mardon skipper (*Polites mardon*). In 2000, when the mardon skipper was listed as a candidate species under the U.S. Endangered Species Act, common wisdom was that its caterpillars fed on fescue and that the butterflies overwintered as chrysalises. In an effort to conserve this butterfly, Xerces and partners conducted surveys across the species' range, studied the impacts of management activities such as fire, and implemented restoration and habitat management at dozens of locations.

Interestingly, when researchers from Xerces and the University of Washington began investigating the skipper's

life history, it was found that its females oviposit on multiple plants, including fescue, sedges, and oatgrass. In addition, field studies by our team suggested that those living in the Cascade Range overwinter as caterpillars. This experience was a clear reminder that in order to successfully conserve a species we must understand what it eats and how it lives.

Many grass-specialist butterflies are known to be declining, primarily due to habitat loss. Currently, there are thirty-two butterflies protected under the federal Endangered Species Act, and one more that is a candidate for protection. Four of the protected butterflies are grass skippers—Dakota skipper (*Hesperia dacotae*), Pawnee montane skipper (*Hesperia leonardus montana*), Poweshiek



Unlike many species, the mardon skipper (*Polites mardon*) has been the focus of much study, which helps inform habitat management plans. Photograph by Tom Kogut / USFS.



The Pawnee montane skipper (*Hesperia leonardus montana*) is listed as threatened under the Endangered Species Act. It occurs only in the drainage system of the South Platte Canyon River in Colorado. Photograph by Craig Hansen / USFWS.

skipperling (*Oarisma poweshiek*), and Carson wandering skipper (*Pseudocopaeodes eunus obscurus*)—but there are many more imperiled grass-feeding butterflies that are not protected under the Endangered Species Act. Habitat loss is a primary threat to these species, and grassland habitat continues to disappear. Other threats, including pesticides and invasive species, also play a role, and the effects of climate change are becoming increasingly apparent.

Grasslands have frequently been plowed under or built upon, their treeless landscapes easy to convert to other uses. More than 98 percent of the tall-grass prairie that covered the Midwest and once stretched from Manitoba to Texas has been destroyed. Other grasslands have fared even worse: those of California's Central Valley and the Palouse prairie of Washington and

Idaho are both reduced to less than 1 percent of their historic area. In the face of such losses, every scrap of grassland habitat becomes significant.

There are seventeen million acres of roadsides in the United States, often dominated by grasses, and these and other rights-of-way present a valuable opportunity to increase habitat and habitat connectivity for butterflies and other insects. Xerces has a long history of working with the Federal Highway Administration and departments of transportation across the country. We have produced many documents for roadside planners and maintenance crews, including scientific reviews and guidelines, which can be found on the Xerces website. We are currently working on a guide to creating climate-smart roadside habitat for pollinators. It will include profiles of imperiled pollina-



Grasslands require ongoing management and care to maintain the open, species-rich conditions that many butterflies need. Carefully prescribed actions such as such as mowing or burning are often necessary to prevent gradual decline and eventual loss. Photograph by the Xerces Society / Anne Stine.

tors, with an overview of the effects, both positive and negative, that roadside management can have on these species, along with recommendations for practices that can contribute to their conservation. We are also working to provide guidance for assisting the four ESA-listed skippers and ten additional species of grass-feeding butterflies—along with a suite of other imperiled pollinators—so that state transportation departments can better manage roadside habitat to protect these underappreciated creatures.

Climate change poses a considerable threat to the biodiversity of our planet, particularly for species that rely

on already declining habitats. Protecting and restoring grasslands has a role to play in mitigating the magnitude of the change in climate and—particularly if we improve connectivity among habitat remnants—is key to sustaining butterflies and other invertebrates that live in these remarkably diverse and beautiful places.

Angela Laws is an endangered species conservation biologist at the Xerces Society, based in California. Her work focuses on incorporating climate resilience into habitat restoration for pollinators and monarch butterflies.

CONSERVATION SPOTLIGHT

Phyllis Stiles: Pollinator Champion and Founder of Bee City USA

Phyllis Stiles built a career by weaving together her concern for the environment and, just as significantly, her desire to serve communities. She led a campaign that worked with local communities to protect fifty thousand acres of the southern Appalachian Mountains, coordinated a North Carolina fund to conserve farmland and the families it sustains, and directed fundraising at the University of North Carolina, Asheville, that, among other things, supported college-preparation programs for minority high-school students. Those achievements create a considerable legacy—but they are not the work for which Phyllis is most widely recognized.

About fifteen years ago, at her husband's urging, Phyllis joined him in learning about backyard beekeeping. Colony collapse disorder was in the news and, as reports grew worse, she knew that she needed to do more than care for a hive or two. Inspired by Margaret Mead's aphorism that a small group of thoughtful, committed people can change the world, Phyllis brainstormed with friends. The result was Bee City USA.

Phyllis started with her home town of Asheville, asking the city council to adopt a resolution declaring the city's commitment to creating habitat, avoiding pesticides, and hosting outreach activities promoting pollinators. When the council adopted the resolution in June 2012, Bee City USA gained its first affiliate.

With her love for bees rapidly expanding into an understanding of the diversity and importance of native species, pollinator conservation became Phyllis's life. Her tireless efforts saw Bee City USA blossom into a network of communities spanning the United States; become the gold standard for protecting native pollinators in cities, towns, and colleges; and spawn a parallel initiative in Canada.

Phyllis retired from Bee City USA last year, but remains actively engaged in promoting pollinators in Asheville. Every individual and community that Phyllis helped through Bee City USA and during her career will have fond memories of her, and knowing Phyllis, enjoy a lasting friendship as well.



INVERTEBRATE NOTES

New Brochure and Webinars Bring Attention to Fireflies

Fireflies—also known as lightningbugs or glow-worms—are some of our most adored insects. Not only are they important components of natural ecosystems, but they have immense cultural, biological, and economic value. Even so, fireflies appear to be declining.

Last year Xerces initiated the Conserving the Jewels of the Night campaign to advance our understanding of fireflies, identify and address threats to their populations, recover populations that have declined, and engage the public in firefly conservation. An important part of this effort is to inspire people to take action for these incredible creatures. A new brochure with fabulous illustrations by our partners at Ink Dwell, *Firefly Conservation: A Guide to Protecting the Jewels of the Night*, does just that. It offers guidance about what fireflies need and what we all can do to help, with the goal of getting people to take action.

We're also reaching out to a variety of audiences to provide conservation tools and information. We've presented



two webinars, one geared toward farmers and farm agency staff and one for a general audience; and in June we are offering a third, for public land managers, hosted by the Natural Areas Association. For more information, see the firefly resources on our website.

—Scott Black

Research: Pesticides in Milkweeds

Concern over monarch butterflies has led to an upsurge in habitat creation on farms and roadsides, in parks and yards. For greatest benefit, such habitats need to be free of pesticides as well as to offer the right types of plants. Xerces partnered with the University of Nevada, Reno, to conduct a study in California into the presence of insecticides in milk-

weed species—which are the sole food source for monarch caterpillars and thus vitally important for their survival.

During June 2019, samples of milkweed leaves were collected from farms, home gardens, retail outlets, and even wildlife refuge lands in California's Central Valley. These were tested for pesticides and the levels of residue were mea-

sured. Our findings, recently published in the journal *Frontiers in Ecology and the Environment*, were disheartening. Not a single site was free of pesticides. Sixty-four different pesticide products were detected, with an average of nine per plant. While there is limited data as to the risk pesticides pose to monarchs, available research shows that 47 percent of the samples contained pesticides at levels that could be lethal to butterflies.

Fortunately, the outpouring of sup-

port in response to these findings has been phenomenal. Farmers, gardeners, government agency staff, and many others in the region all want to play a role in helping monarchs. Already Xerxes is working with a milkweed seed producer to ensure that the plants he grows are free of harmful pesticides. We are also helping home gardeners to source pollinator-attractive plants grown with ecologically sound methods.

—Aimée Code

Book Review: *The Garden Jungle*

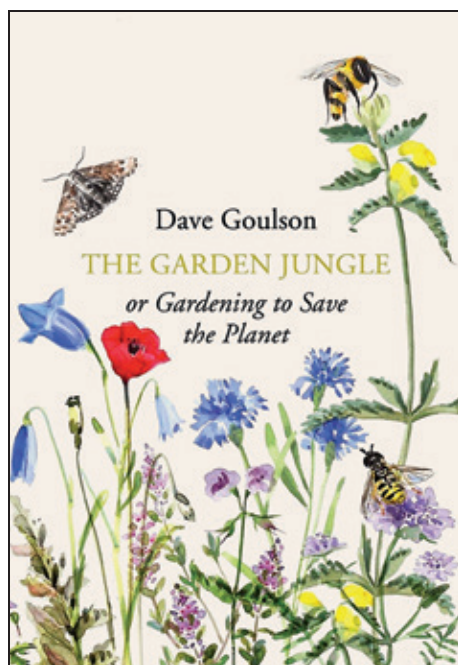
Dr. Dave Goulson is a scientist who combines sound research with the ability to write engagingly for a general audience. His newest book, *The Garden Jungle, or Gardening to Save the Planet* (Jonathan Cape, 2019), is a terrific read, and it is globally relevant, despite at times being focused on the United Kingdom.

Dr. Goulson takes us through why and how to create a garden that works for a host of small creatures, while also maintaining the beauty and function we expect to enjoy there. He begins by discussing the complexity of gardens and plant selection, and then, chapter by chapter, introduces us to animals you will meet in your backyard—along with practical ideas to help create space for them and the systems they support.

You'll learn a new appreciation for earwigs (voracious predators of garden pests, not human brains), worms (world's best composters?), moths (perhaps we should call them night-time butterflies?), and ants (herders, farmers)! Mixed in with all of this is perhaps one of the most sobering chapters you'll ever read, about how pesticides have altered the health of ourselves and our planet.

We must work together to make our yards, parks, and communities less dependent on chemical inputs. That work starts at home—and *The Garden Jungle* outlines the principles that will allow us to take meaningful steps forward.

—Rich Hatfield



STAFF PROFILE

Emily May, Pollinator Conservation Specialist

What got you interested in insects? While I've always been keen on natural history, when colony collapse disorder hit the news I became interested specifically in bees through the lens of food systems and pollination. I was in college and involved with the student farm, which kept honey bees for pollination and honey production, but I soon became interested in the diversity of native bees visiting the flowers we planted.

How did you hear of the Xerces Society? I first learned about Xerces when I did an independent study project on pollinator biology during my sophomore year. The Xerces resources I found then proved extremely helpful in designing a pollinator garden on campus!

What made you want to work here? I've known for more than a decade that my dream job would involve helping to translate pollinator science for the public and supporting on-the-ground pollinator habitat conservation—two things that Xerces sets the bar for. That dream led me to pursue a masters in entomology studying wild bees in Michigan blueberries, and eventually to a position here at Xerces! I feel quite lucky.

What's the best thing about your job? I am constantly learning new things. Developing guidance on pollinator conservation involves deep dives into current research—something I find thrilling—but I'm also always learning new things from the people I work with,



all of whom have an amazing depth and breadth of skills and knowledge.

Who is (or was) your environmental hero? My current hero is Greta Thunberg, who speaks to power with such clarity and gives a resonant voice to the collective anger over inaction on climate.

What's your favorite place to visit? While I've lived in many states over the last ten years, my heart lives in the valley between the Adirondacks and the Green Mountains. Vermont will always be my favorite place to spend time.

What book are you currently reading? I just finished Robert Macfarlane's *Underland*, which explores the human relationship to subterranean spaces through history and into the future. He characterizes humans and rocks with equal skill.

Island Marble Butterfly Finally Receives Federal Protection

The Xerces Society and other conservation groups first petitioned the U.S. Fish and Wildlife Service to protect the island marble butterfly (*Euchloe ausonides insulanus*) in 2002. The USFWS denied protection four years later, citing voluntary conservation efforts. After monitoring by the Washington Department of Fish and Wildlife and others indicated that the butterfly's populations were continuing to decline, in 2012 the Xerces Society again petitioned the USFWS—this time successfully. At the beginning of May, the USFWS listed the island marble as an endangered species under the Endangered Species Act.

Two decades ago, this butterfly was at risk but could be found at multiple sites, including populations on both

Lopez and San Juan islands. During the years spent waiting for protection, the island marble disappeared from most locations and now occurs in only one population within American Camp National Park on San Juan Island, which makes recovery much more difficult. We hope that now that the island marble has been listed, funding can be made available to help the butterfly recover.

In 2019, the USFWS approved a Programmatic Candidate Conservation Agreement with Assurances, a voluntary agreement with landowners to promote conservation that reduces threats and provides for actions to help recovery. Many landowners have signed up for the Agreement, which could give the island marble a chance at survival.



The island marble finally has protection, but work is still needed to help it recover from near extinction. Photograph by Karen Reagan / USFWS.

Protecting Monarch Butterflies

For decades, Xerces has worked to protect and restore habitat for monarchs across the United States. East of the Rockies, we collaborate with farmers, roadside managers, Bee City and Bee Campus communities, and many others to create landscapes that support monarch breeding and migration.

In the West, this work has taken on added urgency as the number of monarchs migrating to California to overwinter has declined by more than 99 percent. A research partnership between Xerces, Washington State University, Tufts University, and the University of Nevada, Reno, has found that if we want to maintain this migration we must immediately focus on protecting and restoring overwintering sites across California, as well as the milkweeds that grow early in the season and the nectar sources that bloom in the early and late

seasons. Xerces is already working to address these important issues.

Intact overwintering sites that have a hospitable microclimate—protected from winter storms and cool enough so monarchs do not burn too many calories, but warm enough so they do not freeze—are vital for sustaining the migration. Xerces staff are working directly with site managers to assess habitat, to identify threats as well as restoration needs and opportunities, and to develop site-specific management guidance, and then to implement these plans.

We also are reaching out broadly with a call to action for farmers, homeowners, and the staff of parks, natural areas, and roadsides to help us ensure that monarchs have adequate milkweed and nectar plants. We are excited to announce that we have hired additional staff to provide conservation planning,



To rebuild the numbers of western monarchs and sustain their migration, Xerces is working to ensure that there are milkweeds for breeding, flowers for nectar to fuel their long-distance flight, and overwintering sites in which they can shelter. Photograph by USFWS Midwest.



Splendid tiger beetle (*Cicindela splendida*), photographed by Bryan E. Reynolds.

Your Legacy for Invertebrates

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

We highly recommend that you discuss your planned giving options with your professional advisor in order to choose a gift that works best for you and your family. If you have questions or would like to inform us of your plans, please complete our online planned giving form at xerces.org/donate/planned-giving, send an email to membership@xerces.org, or call us at (855) 232-6639, option 2.

We'd love to hear from you.

technical support, and training to farmers and ranchers, as well as to staff from the Natural Resources Conservation Service and resource conservation districts. To ensure that plants are available, we are working with native plant nurseries to increase the supply of both nectar plants and milkweed and we are providing ready-made plant kits for farms, schools, and other groups to support monarch habitat.

We also continue to work with our community scientists to monitor overwintering sites and identify milkweed habitat across the West. This allows us to prioritize restoration of the most important habitats and to understand how our efforts are helping monarchs. Western monarchs are highly imperiled, but Xerces will continue to use our resources wisely so that future generations will be able to witness this majestic butterfly.

Ready-Made Plant Kits Jump-Start Habitat Projects in California

Many of California's pollinator insects are declining. The best-known is probably the western monarch population, but numerous other butterflies and bees also face threats. To increase the amount of habitat available for these insects, for the second year in a row the Xerces Society is offering "habitat kits" that contain climate-smart native plants that support monarchs and other local pollinators in the state—everything

needed to create a high-quality patch of habitat. These include native milkweeds, the host plants for the monarch, and a variety of flowers that provide nectar for bees and butterflies.

The kits, each of which contains more than a thousand plants, are intended for use on large-scale landscapes. There are four basic kinds: two herbaceous kits for riparian areas and meadows, a riparian shrub kit, and a hedgerow kit. To cater to California's broad diversity, we've made each of these four types available in variations that are tailored for three geographic regions: the Central Coast and coastal foothills, the Central Valley, and the Sierra Nevada foothills.

Last year's kits were a big success. We provided thirty-two of them—a total of 51,200 plants—which added vital habitat on farms and natural areas, in parks, and at schools. This year, we received fifty-eight applications, which we are currently reviewing. Although to date we have offered kits only in California, we will begin providing them in other parts of the country in 2021.



Milkweeds are essential for monarch caterpillars. Photograph by the Xerces Society / Emma Pelton.

Nebraska Bumble Bee Atlas Aims to Protect Important Pollinators

A large state with diverse landscapes from the High Plains and Pine Ridge in the west, through the Sandhills and on to the riparian forests of the Missouri River in the east, Nebraska is home to about twenty species of bumble bees. Near the middle of the United States, Nebraska hosts an intriguing overlap of species typically found in both the eastern and western regions. It's a bit like the center of a Venn diagram.

With such a large area and so many species, it can be a challenge to gather the information on where different species live and what habitats they use, data that is needed to help guide conservation work. That is where the Nebraska Bumble Bee Atlas comes in. This statewide community science project—a collaboration between the Xerces Society and the University of Nebraska, Lincoln, with support from

the Nebraska Environmental Trust—welcomes all who wish to participate. The goal is to have volunteers across the state look for bumble bees, and then to report back their findings.

Xerces offers online workshops that provide the necessary skills, knowledge, and confidence to participate in this effort. Surveys are catch-and-release, so no bees are harmed, and data collection can be done using a smartphone. Ultimately, the information gathered this way will help our conservation biologists prioritize work with farmers, land managers, and gardeners to protect and restore habitat for bumble bees.

Not in Nebraska? We have atlas projects in Oregon, Washington, and Idaho, and will be launching them in other states in 2021—but you can help us to understand and conserve bumble bees anywhere in the United States and Canada by joining Bumble Bee Watch.



Volunteers with the Nebraska Bumble Bee Atlas are gathering information to help protect the state's pollinators. Photograph by the Xerces Society / Katie Lamke.

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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:

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Male solitary bees do not have a nest to return to, so they rest on plants overnight. Some species, such as these white-banded digger bees (*Amegilla quadrifasciata*), sleep in clusters. Photographed in Morocco by David Marquina Reyes / Flickr.

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On the cover: Male and females of the Diana fritillary (*Speyeria diana*) are dramatically different. Females are black with blue patches; the males are largely orange with black on the upper sides of their wings. Photograph by Bryan E. Reynolds.