WINGS

ESSAYS ON INVERTEBRATE CONSERVATION

THE XERCES SOCIETY FALL 2013

CONTENTS

Much of Xerces' work is focused on habitat, which is central to successful conservation efforts. When habitat disappears from our urban and rural landscapes, so too does the rich diversity of invertebrates that underpin a healthy environment.

In Memoriam: Bumble Bees

Scott Hoffman Black

Sandwiched between the bustling metropolitan area of Portland and Oregon's farm-dominated Willamette Valley, Wilsonville is a quiet town that, sadly, recently received global exposure as home to the worst bumble bee kill ever recorded. Reports from concerned citizens of dead bees outside a suburban shopping center alerted Xerces staff to the unfolding tragedy. Our scientists documented the event, collected samples, and engaged the Oregon Department of Agriculture to test the bees for poisoning. ODA tests confirmed that the kill was due to an insecticide that had been applied to more than fifty blooming linden trees to reduce aphid honeydew dripping onto parked cars. Linden is a magnet for bees and over several days fifty thousand bumble bees died, their bodies carpeting the parking lot. Additional bee kills are being reported across the United States, including one in Hillsboro, Oregon, where hundreds of bumble bees died. All these incidents have one thing in common: a neonicotinoid insecticide called dinotefuran.

These tragedies should be a wake-up call about neonicotinoid insecticides for policymakers, the horticulture industry, and consumers. Neonicotinoids are widely available and commonly used on the farms, gardens, parks, and streets of North America. Xerces is working hard to educate the public on the threats posed by these chemicals. We are engaging garden stores to remove neonicotinoids from their shelves, and are continuing to work with national legislators to push the Environmental Protection Agency to review these insecticides for environmental risks.

Fifty thousand bumble bees died after drinking nectar from insecticide-treated linden trees in a suburban parking lot. The City of Wilsonville and the Xerces Society quickly stepped forward to cover the trees in fine-meshed netting to prevent more bees from reaching the toxic nectar. Photograph by Mace Vaughan.

As a direct result of our actions in shining a light on the Wilsonville incident, the Oregon Department of Agriculture has banned the use of dinotefuran within the state for six months while they reevaluate its safety.

Our work on pesticides is not new. Over the past decade we have stepped in to stop scientifically unfounded pesticide use and have published influential reports. In 2004, we worked with other organizations to successfully compel the State of Idaho and the USDA to abandon plans to treat grasshoppers on millions of acres of public lands. Because of our advocacy the project was scaled back to only a few thousand acres. More recently, we published *Are Neonicotinoids Killing Bees?*, a comprehensive review of the impacts of neonicotinoid insecticides on bees, and *Ecologically Sound Mosquito Management in Wetlands*, which discusses the risks, benefits, and nontarget impacts of mosquito control practices, and outlines effective ways to control mosquitoes and conserve wetlands.

The neonicotinoid report has been used by organizations as varied as the European Parliament, county commissioners, the EPA, and media outlets, and was highlighted in a briefing to U.S. Senate staffers in early 2013. The mosquito report is being used as the basis for organizing stakeholder meetings and meetings with elected officials, as well as for developing materials that empower citizens to effectively protect their local wetlands. This report also helped us stop pesticide spraying on more than ten thousand acres in and around Bandon, Oregon.

In addition, our pesticide reduction efforts form part of training programs for thousands of farmers and land managers, and we are in the process of developing guidelines for science-based approaches to encouraging beneficial, pest-controlling insects.

Despite the depth of our involvement in this issue, our pesticides work has always been tucked into other programs. I am pleased to tell you that thanks to the enormous generosity of our members, we have hired a full-time pesticide program specialist. This new staff member will work with other program staff to build on our earlier work and pursue greater pesticide reduction.

You can be directly involved with the movement for change:

Sign the Pollinator Protection Pledge on our website and make a public statement of your commitment to protect pollinators and their essential habitats.

Stop using neonicotinoids in your yard or garden.

Report mass bee deaths in your community to your state pesticide control official and submit a report to the Xerces Society on our website.

Donate to the Xerces Society to enable us to respond rapidly to these types of events and be proactive in our effort to limit pesticide use across the country. (And if you are not a Xerces Society member, join today!)

Contact your members of Congress and ask them to support the Saving America's Pollinators Act (sponsored by Representatives John Conyers and Earl Blumenauer). This Act would suspend certain uses of neonicotinoids until the Environmental Protection Agency reviews these chemicals and makes a new determination about their proper application and safe use.

The Art and Science Of Restoring Pollinator Habitat

Eric Lee-Mäder

We are lucky to count some of the most innovative and progressive farmers in the country among the project partners in our pollinator conservation program. None of our habitat restoration work on farms would be possible without their genuine friendship and trust in our efforts. It is striking how often plans for restoring pollinator habitat begin in conversations around coffee tables or riding around in pickup trucks, talking about crops, family, and life.

Doug and Anna Crabtree farm several hundred acres of organic heirloom grains, legumes, flax, and oilseed crops near Havre, Montana, and our partnership with them exemplifies this type of relationship. Having first met them at a farm conference in Washington, my colleague Jennifer Hopwood and I have now collaborated with them to restore dozens of acres of wildflower strips on their land. In this process of sharing meals and conversations and hanging

Doug and Anna Crabtree have integrated native wildflower strips like this for pollinators and other beneficial insects throughout the twelve hundred acres of their Montana farm. Photograph by Jennifer Hopwood.

Habitat restoration is not all glamor and sunshine. Here Xerces' Jessa Guisse offers guidance during the seeding process. Photograph courtesy Glenn County (California) Resource Conservation District.

out together at other farm conferences, we've developed a friendship that makes trips out to their farm hugely enjoyable as well as more productive.

The Crabtrees have generously shared their expertise in regard to seeding equipment and seedbed preparation. We, in turn, have provided information about the pollinators and beneficial insects that are best suited to supporting their crops, along with ways to increase the abundance of those insects. Together we all work to develop an expanding vision for their land that fosters deep biodiversity and helps to build a new model for profitable farming.

Since its inception more than a decade ago—sparked by a collaboration with Claire Kremen, then at Stanford University—the Xerces Society's pollinator conservation program has undertaken a broad array of projects that have placed pollinators squarely in the realm of mainstream conservation. One effort that increasingly occupies our attention is habitat restoration, most of which occurs on farms, with the direct goal of supporting the pollination of crops. This strategy, thanks in part to Xerces-sponsored research, is firmly supported by an extensive and growing body of data from such university partners as Claire Kremen, Rachael Winfree, Rufus Isaacs, Neal Williams, and David Biddinger, demonstrating that, where sufficient habitat exists, many types of farmers can get all of their crop pollination needs met by wild native bees.

Our process for creating such habitat starts with working with farmers to understand their goals and craft a common vision. The pollinator habitat we strive for typically takes the form of native shrub hedgerows and wildflower meadows—"bee pastures"—on the edge of crops or in corners of their farm that for reasons such as soil conditions or high water table would be better main-

tained as insect habitat than as cropland. In addition to bees, these features support butterflies, songbirds, and other wildlife, including beneficial predators of crop pests. With goals determined, we turn to the more pragmatic steps of selecting appropriate native wildflower species, preparing sites for planting, and following up with weed management.

These steps are relatively easy on a small scale; carrying them out on large, multi-acre sites, however, often requires special expertise. To address that need we have built a talented team comprising staff members with diverse backgrounds in restoration ecology, horticulture, farming, and entomology. Building upon prior experience, our staff members regularly field-test new restoration methods for maximizing wildflower richness and reducing weed competition. Although native-plant restoration is a fully fledged discipline, there is often no precedent for establishing stable, wildflower-dense plant communities specifically for pollinators. As a result, Xerces staff ecologists are creating the art and science of pollinator-habitat restoration from the ground up.

Figuring out what to plant is a pivotal step in any restoration project. Aside from considering such obvious factors as which native wildflowers might be best adapted to local soil and climate conditions, we screen species for commercial availability, cost, weed potential, and actual attractiveness to pollinators, a determination based upon field observations by university partners and our own staff. Taking all these factors into account, we design custom seed mixes for our projects. The particular

Restoring flower-rich habitat to farmlands is vital for building resilient pollinator populations. Partnerships among growers, agencies, and nonprofits are keys to successful habitat restoration. Photograph by Don Keirstead, New Hampshire NRCS.

plants chosen differ according to the region, but they often include milkweed, coneflower, bee balm, lupine, aster, and goldenrod. Designing the seed mix for a given project requires a detailed calculation of how many seeds should be planted per square foot, what percentage of each species should be represented in the mix, and how much total seed needs to be purchased.

One of the challenges we sometimes face is a lack of commercial availability of certain wildflower or shrub species. To address this problem, we have developed a model approach for working with the native-plant nursery industry to bring uncommon plants into production, helping to generate a stable supply for use in restoration. To accomplish this, we first locate wild populations of the plant to harvest seed from, making sure not to over-collect from these sources. We then work with partners—such as the USDA Natural Resources Conservation Service's network of Plant Materials Centers—to grow test plots using the wild-collected seed in order to understand its growth requirements and develop proper techniques for managing the plants as a seed crop. Finally, we harvest seed from the test plots and transfer it, along with the production protocols, to private-sector native-plant nurseries for them to use in producing the seed commercially. The results have been excellent; our Project Milkweed, for example, has succeeded in developing large-scale commercial sources of milkweed seed for restoration in California, Texas, and several other states.

Rattlesnake master (*Eryngium yuccifolium*) is an excellent plant for bumble bees in most of the eastern United States. Photograph by Steve Hendrix.

Back on the farm, a less glamorous side of the restoration process is the site preparation prior to planting. In most cases, areas available for restoration are highly disturbed, and often they are dominated by invasive weeds, the removal of which is a critical factor in a project's success. Like those of other restoration ecologists, our site-preparation methods rely upon understanding what conditions are favorable to weeds, and sometimes upon understanding which herbicides are most effective at eliminating them.

While chemical techniques may be acceptable to many farmers, an increasing number of organic growers are interested in habitat creation around their fields. To support them, we are working to improve non-chemical approaches to weed removal, such as solarization (killing weeds by covering them with greenhouse plastic) or the use of temporary cover crops to out-compete the weeds and leave behind clean ground for re-

The size of the site will determine the seeding technique. The belly grinder shown here is great for small areas. Large sites may need specialized equipment for seeding wildflowers. Photograph courtesy New Hampshire NRCS.

planting with native species. So far the results have been mixed, and, because they rely on substituting intensive labor for herbicides, they have typically been most successful in small areas. Because we want habitat restoration to work efficiently on a much larger, multi-acre scale, we are investing further effort in testing and improving these non-chemical strategies with the hope that in the near future they will rival the effectiveness of site preparation with herbicides.

Once site preparation is complete, successful planting of hedgerow shrubs for pollinators is generally straightforward. Following the landscape design developed with the farmer, we now install the plants, often providing irrigation and a lot of mulch for weed control.

Establishing large meadows from seed, though, can be much more complex—particularly when planting a variety of different species that have diverse seed sizes and shapes. Adding to the difficulty, many wildflower seeds require a period of cold-weather exposure before they will germinate, so something as simple as the time of sowing can be the difference between creating a field of wildflowers and ending up with a patch of weeds. Depending on the size of the area, we may pre-mix the seed in buckets and hand-scatter it like chicken feed, or we may use modified lawn and garden seeders. On large sites we sometimes work with local conservation agencies that have specialty wildflower-seed planters, which can sow many acres in a day, precisely depositing individual seeds at their required depth and spacing. The configuration of such planters is often an exercise in head scratching, patience, and colorful language, but the end results can be fantastic.

Even when everything goes well in the restoration process, nearly every

project requires occasional follow-up management to maintain floral diversity and to stop encroachment by invasive weeds. Fortunately, these management needs usually decline as a plant community stabilizes and matures. Our goal is to establish mature wildflower meadows that require only a few hours of spot weeding per acre on an annual basis, or hedgerows that need to be trimmed back just once every few years.

Beyond weed management, we are now testing a wide range of innovative long-term management practices, including inter-seeding new wildflower species into mature meadows, selective grazing by livestock, and specialized pruning of hedgerow plants—coppicing, for example, a technique traditionally used in parts of Europe—to improve wildlife structure.

A key result of the pollinator conservation program's restoration work is a growing list of success stories that are bridging the gap between agriculture and conservation, from Maine to Florida to California. In some cases our staff members design and carry out these steps on their own; more often, however, we work in partnership with the farmers themselves—who provide not just inspiration for most projects, but the labor as well—and with an ever-widening circle of state and federal agency staff, including folks at the USDA Natural Resources Conservation Service.

The NRCS support is particularly important in helping farmers to offset the costs of buying seed and preparing areas for restoration through programs that provide financial assistance. This partnership with the NRCS and other agencies has led to the establishment of more than 120,000 acres of new pollinator habitat on hundreds of farms across the United States. And we're just getting started: we anticipate adding many more acres in the coming years.

Of course, the steps outlined here are necessarily somewhat simplified and idealized. In the real world, every phase of the restoration process is under constant assault from events you never anticipate: the unprecedented week of 80 degree February weather in Wisconsin that causes wildflower seed to germinate prematurely only to be killed by a late frost, the flash flood that washes away all of the seed from a restoration site, or the drunken driver who speeds through your newly planted hedgerow. Each of these events has actually happened to one of our projects, and in such moments the science of habitat restoration gives way to the art, a process informed by intuition and patience and the ability to laugh.

Ultimately, you plant more seed, pull a few more weeds, and carry on. The resulting landscapes are never perfect, but the impact on bee communities is nearly always self-evident; within a year or two of establishment, pick any warm, sunny day, walk these new meadows or hedgerows with an ear toward the ground, and you hear the gentle, constant, unmistakable hum of success.

Eric Lee-Mäder is assistant director of Xerces' pollinator conservation program.

We have developed a collection of guides for rural landowners and conservation agencies on how to create pollinator habitat in various regions of the United States. These guides are available for download at www.xerces.org/pollinator-conservation.

Food Chain Restoration: Reconnecting Pollinators with Their Plants

Gary Paul Nabhan

At dawn on this year's spring equinox, a group of people gathered in Patagonia, Arizona, to declare the Sonoita Creek–Upper Santa Cruz River watershed the Pollinator Capital of the United States. An interpretive sign, erected in a pollinator garden on Patagonia's village green, noted that hundreds of species of native bees, dozens of species of butterflies and moths, fourteen species of hummingbirds, and two species of nectar-feeding bats regularly frequent the native flowers in this semi-arid landscape. But the Patagonia community has not merely been interested in how much pollinator diversity has been recorded throughout this watershed. Its citizens and its nonprofit and for-profit organizations have joined forces to catalyze the Borderland Habitat Restoration Initiative, which aims to ensure a safer place for pollinators, their nectar sources, and, in the case of butterflies and moths, their larval host plants.

The rallying cry for this initiative is a deceptively simple-sounding phrase:

Arizona's semi-arid Sonoita Creek–Upper Santa Cruz River watershed is home to an extraordinarily rich and diverse community of pollinators. Photograph courtesy BLM.

"food chain restoration" (a synonym of the phrase "food web restoration," which ecologist Andy Dobson has been employing for nearly a decade). When local resident and world-renowned ecologist Ron Pulliam began to employ this term to describe our work, he sought to emphasize that ecological food webs need to be restored from the bottom up, by reinitiating hydrological flows that will stimulate plants at the base of the food chain to flower and fruit. His working hypothesis is that certain habitats have a better chance of being fully restored by building food chains that support pollinators, frugivores (fruit-feeders), and herbivores, as well as predators, than they do by simply reintroducing "apex" predators, such as jaguars or wolves, which supposedly control ecosystems from the top down. But the term "food chain restoration" also resonates for me at another level. If we bring wild pollinators back into the wild edges of the working landscapes of farms, ranches, and orchards, it is likely that they will provide yield stability to cultivated crops, such as vegetables, legumes, fruits, and nuts, upon which our nation's food security depends.

Pulliam is out to test his "bottom up" restoration hypothesis in a series of carefully designed ecological restoration experiments situated along the floodplains of Sonoita Creek and a tributary, Harshaw Creek. The phenology of newly planted pollinator-attracting shrubs is being monitored for the second year in a row, along with estimates of the intensity of floral visitation by pollinators. One goal is to determine how much influence these native shrub plantings have on the "background" pollinator fauna of the surrounding area.

At the same time, Caleb Weaver and I are adapting Pulliam's monitoring protocols to determine the effects of hedgerows of pollinator-attracting native plants on pollinator abundance around fields, orchards, vineyards, and

The Sonoita Creek watershed supports nearly 60 percent of the 240 species of butterflies known from southern Arizona, including the sachem skipper (*Atalopedes campestris*). Photograph by Bryan E. Reynolds.

Healthy populations of bees are central to both bountiful crops and abundant wildflowers. Cactus bees (genus *Diadasia*) foraging in cholla flower. Photograph by Bryan E. Reynolds.

gardens in three Arizona counties along the border between the United States and Mexico. With funding from a USDA grant, we have helped farmers and orchard keepers plant twelve new hedgerows in southern Arizona, and many of these on-farm habitats have now been certified as "bee-friendly" food-producing landscapes by Partners for Sustainable Pollination.

It should come as no surprise to members of the Xerces Society that much of this work has been guided by staff members Mace Vaughan, Eric Lee-Mäder, and Brianna Borders. Vaughan's lectures and workshops in the Southwest over the last two years have attracted scores of participants to this cause, and more than 120 volunteers have helped us plant pollinator-attracting hedgerows in the region. While it is still too early to gauge the extent to which these new plantings are affecting fruit and seed set for food crops, the survival rates and flowering activities of the native plants we've selected have been quite high.

Of course, these efforts are not merely about getting good numbers; they are also about reinvigorating curiosity and wonder about pollinators among the Southwest region's residents and eco-tourists, both young and old. This summer, an Earth Care Youth Corps of six teenagers helped to collect milkweed pods, build nurseries, and sow seeds of the twenty species of milkweed (*Asclepias*) that occur in Santa Cruz County, Arizona. The students learned about the importance of milkweeds to monarch (*Danaus plexippus*), queen (*D. gilippus*), and soldier (*D. ereisimus*) butterflies that frequent their home neighborhoods, and about threats to monarchs as well. We hope that they have taken back to their high schools a deeper understanding of the monarchs on their migration through the region

"Bottom up" restoration ensures habitat for butterflies. Gulf fritillary (*Agraulis vanilla*), photographed by Bryan E. Reynolds.

and pride in the fact that they live in one of the most diverse milkweed communities in the entire country.

These three butterflies in the genus *Danaus* are but a small part of the extraordinarily rich fauna of Santa Cruz County, which, over the years, has attracted exploration and documentation by the likes of lepidopterists Richard Bailowitz, Jim Brock, Kilian Roever, and Ken Davenport. At least 135 of the 240 species of butterflies known from southeastern Arizona occur along Sonoita Creek and its tributaries, some of which reach into the United States only within this watershed. These include the giant swallowtail (*Papilio cresphontes*), the sachem skipper (*Atalopedes campestris*), the gulf fritillary (Agraulis vanilla), and the West Coast lady (V*anessa annabella*), which are widespread but not abundant in the region, as well as the regionally rare Mexican fritillary (*Euptoieta hegesia*). The elf (*Microtia elva*) and the aforementioned soldier butterfly are occasional immigrants to the watershed.

By propagating, transplanting, and protecting the nectar and larval host plants for many of these species in our pollinator gardens and on-farm hedgerows, we have already witnessed an increase in the local abundance of butterflies such as the pipevine swallowtail (*Battus philenor*), which remains active twelve months a year in this area. Our attention to larval host plants as well as nectar and roosting sources for butterflies is making our planning of additional hedgerows and pollinator gardens more complex but also much more rewarding. Already, we are developing a trail along the village green from a new "generalist" pollinator garden to an older butterfly garden in Patagonia, and we are planning a hawk moth garden, a bat garden, and a hummingbird garden along a walkway that leads to the community's vegetable garden. All will have interpretive signs that remind visitors of the diversity of pollinators in this special place and explain their ultimate importance to our food security.

The bee fauna of Sonoita Creek has been considered by such entomologists as Stephen Buchmann, D. P. Hurd, and E. G. Lindsley to be just as exciting as the butterflies; more than six hundred species of bees are native to southern Arizona. The all-yellow Morrison's bumble bee (*Bombus morrisoni*) and the large, striped Sonoran bumble bee (*B. pensylvanicus sonorus*, one of the target species for Xerces' Project Bumble Bee) frequent the watershed, as do four genera of sweat bees and two genera of squash and

gourd bees. By constructing fences of dead flower stalks of century plants and the shrub known as desert spoon, we have increased the local abundance of large carpenter bees (*Xylocopa*). On the edges of the same orchards and fields, our plantings of buffalo gourds, coyote gourds, and devil's claw have attracted smaller bees that are far more loyal to certain crops and their wild relatives than is their naturalized competitor, the European honey bee.

The habitat restorationists and agro-ecologists involved in our projects have been rewarded to learn that sociological surveys of southern Arizonans indicate a great deal of interest in sustaining populations of pollinators of all kinds. A growing number of people in the regional business community recognize that the presence of so many kinds of hummingbirds and butterflies is vital to the ecotourism activities that provide significant revenues to rural populations. And they are just as aware that if native bees suffer further declines, the farming and ranching economies of the region might be adversely affected.

These perceptions have bolstered our hope that food chain restoration can help to generate a true "restoration economy" for the now-impoverished borderlands region, one in which new jobs on farms, in native plant nurseries, and at nature-tourism destinations would be most welcome. Our vision is that the return of formerly forgotten pollinators will not only curb the ongoing extinction of ecological relationships that plagues the continent today, but will also return economic health and well-being to the rural communities along the border that choose to be good stewards of such relationships.

Gary Paul Nabhan, an advisor to the Borderlands Habitat Restoration Initiative, holds the W. K. Kellogg Endowed Chair in Sustainable Food Systems at the University of Arizona. His books include The Forgotten Pollinators *(with Stephen Buchmann),* Conservation of Migratory Pollinators and Their Nectar Corridors in Western North America*, and the newly released* Growing Food in a Hotter, Drier Land.

A diverse community of pollinators always includes beetles. Blister beetle (*Epicauta ferruginea*), photographed by Bryan E. Reynolds.

Providing Year-Round Habitat For California Monarchs

Sarina Jepsen

It was in late October 1995 that I first saw an aggregation of overwintering monarch butterflies. A freshman at the University of Oregon, I attended a conference at the University of California in Santa Cruz, hometown to one of the best-known monarch wintering sites, with the ulterior motive of getting to see this phenomenon. When I arrived at Natural Bridges State Beach, I remember feeling a sense of wonder at all of these living beings in one place, some packed like papers in a file cabinet, others drifting through the air on their enormous wings. I recall contemplating how they seemed to be both extremely fragile and extremely resilient.

That year, there were an estimated fifty thousand monarchs overwintering at Natural Bridges, a population typical of the 1990s. Santa Monica College biology professor Walt Sakai, who performed a lot of the early research characterizing the California overwintering sites, noted in this era that Natural Bridges was the largest site in California, historically hosting as many as two hundred thousand monarchs. In the past decade, however, yearly counts of monarchs at Natural Bridges have fallen well below ten thousand, and the trend at that site appears to be the norm for many of the hundreds of other overwintering sites along the California coast.

Working on the conservation of endangered species, I tend to think of human-induced changes that lead to extinctions happening over an entire century, or at least since the time my grandparents were my age. I've been

Once proposed as the United States' official national insect, the monarch butterfly (*Danaus plexippus*) has a loyal following. Photograph by Bryan E. Reynolds.

Scattered along the Californian coast are hundreds of tree groves to which monarchs migrate each year to overwinter. Populations of the butterfly have declined dramatically in recent years. Photograph by Carly Voight.

surprised to realize that, in my adult years, I have already witnessed a striking decline of one of the world's most charismatic animals. Reports from the monarch overwintering sites in Mexico—which this year hosted about sixty million monarchs (a couple of orders of magnitude larger than California's overwintering population, estimated at only a few hundred thousand)—state that there were fewer monarchs present this past winter than in any previous year during the two decades that they have been tracked.

Although monarchs are admired by so many, we know surprisingly little about their population dynamics, the magnitude of the decline that we've witnessed, and the causes of that decline—particularly in the western United States. One recent study by Shawna Stevens and Dennis Frey of Cal Poly (California Polytechnic State University in San Luis Obispo), however, concluded that changes in precipitation over a ten-year period were strong predictors of the variation in numbers of monarchs overwintering in California. Specifically, in years when drought conditions prevailed in potential breeding areas, monarch numbers at overwintering sites decreased, and in years when breeding areas received a lot of rain, the monarch overwintering population was larger. This can probably be attributed to drought conditions leading to fewer

Contrary to the belief that monarchs prefer eucalyptus over native tree species, recent research has shown that this is not necessarily true. Photograph by Carly Voight.

milkweed plants for monarch caterpillars to eat and fewer flowering plants of all types for adult monarchs to use for nectar. Furthermore, when there is a drought, the plants that remain may be stressed and yield foliage or nectar of reduced quality. This is particularly concerning for the future of the monarch migration in the western United States, since climate-change models predict that these drought conditions will worsen in the coming decades.

In the face of these changes, it is essential that we protect and restore existing breeding and overwintering habitat. In addition to drought, we know that there are other, albeit less well-studied, factors that are also likely to be disrupting monarch habitat and contributing to the butterfly's decline. Land conversion and roadside mowing, as well as other practices—herbicide use, for example—are likely contributing to a loss of milkweed in the western part of the country, as they have in the Midwest. East of the Rockies, the increased use of herbicides on crop land (primarily due to the large-scale planting of genetically modified, herbicide-tolerant crops, which allows broad-scale herbicide use

to kill weeds while sparing crops) has led to a loss of milkweed for monarch caterpillars. Beyond the breeding areas, monarchs are especially vulnerable when they are overwintering, because so many individuals are concentrated in such a small space. And many of the groves of trees that shelter overwintering monarchs are being destroyed or becoming less suitable for the butterflies, concentrating them even more. Sixty-two or more groves have been rendered unsuitable for monarchs in the past few decades as the trees within these sites have senesced; lost limbs; succumbed to disease, severe storms, or fire; or been removed and replaced with housing developments. In fact, at least twenty-seven overwintering groves have had houses built on them, and two more sites are currently threatened by development.

To survive winter, monarchs require a very specific microclimate at these sites, including protection from wind and storms, an absence of freezing temperatures, exposure to just the right amount of sunlight, high humidity levels, and access to nectar and water. Even where the roost-trees themselves are intact, changes to the forest structure in the surrounding area can have a dramatic effect on a site's microclimate, and thus on its ability to support overwintering monarchs. Fortunately, this capacity for change means that the forest structure can be modified and enhanced over time to create conditions that are more suitable.

Active management may be the only way to maintain or restore habitat for these wintertime aggregations of butterflies. Many monarch researchers, including Stuart Weiss, Kingston Leong, and John Dayton, have spent years studying the habitat requirements of monarchs and working with land managers to modify sites so that they will continue to support overwintering monarchs.

With support from the Monarch Joint Venture, the U.S. Forest Service and the Xerces Society have been working to restore habitat at one site on the Big Sur coastline that historically hosted up to thirty-five thousand returning monarchs, but now rarely sees more than a thousand. This site includes one grove that monarchs use throughout the winter, one that is used only in the fall, and one that was used historically but is no longer occupied. Within these groves, many of the pines, cypress, and eucalyptus trees are beginning to senesce or are diseased. In addition, there are gaps in the structure of the forest canopy that, if left unmanaged, will allow strong north and northwest winds to reach monarch clusters. Because this is a popular recreation area, we are working with Forest Service staff to create a plan that will allow hazard trees (those that might collapse or drop branches on visitors) to be removed and new trees to be planted in key areas to maintain a buffer against harsh winds. We anticipate that these management activities, over time, will enhance the site's suitability for monarchs and lead to the recolonization of the historic grove.

The Xerces Society is also collaborating with researchers to develop general management guidelines for California overwintering sites. These include defining the boundaries of a site, monitoring monarchs and habitat conditions, providing flowers for nectar sources, assessing, trimming, and removing hazard trees, and planting re-

The Monarch Butterfly Sanctuary in Pacific Grove—"Butterfly Town, USA"—is one of the best-known places to see overwintering monarchs. Photograph by Candace Fallon.

placement trees. These guidelines will serve as a tool for land managers and private landowners who are responsible for monarch overwintering sites.

Efforts to restore the sites can be controversial, since the majority of them are dominated by eucalyptus trees, which are exotic and in many places invasive. Although monarchs form clusters on eucalyptus, recent research by Jessica Griffiths and Francis Villablanca of Monarch Alert suggests that monarchs do not prefer eucalyptus, and in fact use native trees more than would be expected given their low density relative to eucalyptus. Restoration of overwintering sites with native species, though, can take decades because many of California's native conifers are relatively slow-growing. More than a decade ago, for example, monarch researcher Stuart Weiss guided a restoration effort at Pacific Grove's Monarch Butterfly Sanctuary, planting native Monterey pines and cypress and nonnative eucalyptus to replace diseased Monterey pines. In the years since then monarchs have continued to cluster in the faster-growing eucalyptus, but now that the newly planted native trees have become large enough they have also begun to occupy those.

The migration and winter clustering of monarchs is a remarkable natural phenomenon. In the face of climate change, habitat loss, and a whole suite of other stressors, restoration of monarch habitat is one thing that we can do to help these fragile, resilient animals maintain their foothold in the world.

Sarina Jepsen directs Xerces' endangered species program.

The Interagency Special Status/Sensitive Species Program

The U.S. Forest Service/Bureau of Land Management Interagency Special Status/Sensitive Species Program is not a name that easily rolls off your tongue. Even as an acronym—ISSSSP—it can be hard to say. Behind the forbidding name, though, is a program responsible for the conservation of a diverse range of flora and fauna on millions of acres of federal lands in the Pacific Northwest. The ISSSSP's work focuses on species that are deserving of conservation attention but not protected under the Endangered Species Act. Indeed, one goal of the program is to conserve these species in order to avoid ESA listing.

The ISSSSP is charged with protecting a wide variety of taxa, including amphibians, fish, mammals, reptiles, fungi, lichens, and plants, as well as a whole suite of invertebrates. For the past five years, the Xerces Society has partnered with the ISSSSP to gather information on Northwest invertebrates and to help identify rare and declining species that have populations on Forest Service or BLM lands. To date, this effort has garnered extensive information on more than 150 species, enabling the most imperiled of them to be prioritized for conservation. Twenty-nine species have been reclassified as sensitive based on both conservation need and documented occurrence on agency lands. While this status change might not sound like much, it is an important driver of conservation efforts. When one of the agencies is developing a project—for timber operations or road construction, for instance—it must be evaluated to determine the potential effect of the project on sensitive species. Project plans might then be re-worked in order to reduce impacts on sensitive species or even potentially to benefit them, whereas absent this status projects may occur without taking them into account. Because many of these species have no federal or state protection, such status change is an opportunity for them to receive basic conservation consideration.

This work empowers staff biologists across different National Forests and BLM districts to better understand where these species can be found, how to identify them, and then what conservation actions should be taken to ensure their continued survival. To this end, the ISSSSP provides strategic funding to National Forests and BLM districts to undertake projects to help understand and protect these species, such as funding surveys to document all populations. This, of course, helps with project planning for timber sales or recreation sites, and allows agencies to work to ensure that these species are not harmed. In the past two years the ISSSSP has provided funding for Xerces to implement three rare-butterfly identification and management workshops (additional funding for the first workshop came from the U. S. Fish and Wildlife Service) as well as a workshop on the California shield-backed bug, a rare species that has not been recorded for several decades. Well-

attended by Forest Service and BLM staff members, the workshops provided them with skills needed to survey for these species and information that allows them to understand the threats these animals face and their habitat needs.

The ultimate goal of the ISSSSP is conservation. Great strides have been made in understanding the conservation needs of typically overlooked animals such as the hairy-necked tiger beetle (*Cicindela hirticollis siuslawensis*), the Oregon plant bug (*Lygus oregonae*), the western bumble bee (*Bombus occidentalis*), the Coronis fritillary (*Speyeria coronis* nr. *coronis*), and the salmon coil snail (*Helicodiscus salmonaceus*).

One excellent example of how the ISSSSP has made a difference is with the mardon skipper butterfly (*Polites mardon*). The ISSSSP convened a working group to develop a conservation strategy, funded surveys across the species' range, and partnered with Xerces to develop management plans for mardon skipper sites. These plans have led to removing small trees that have encroached into butterfly habitat, blocking access to off-road vehicles, and fencing some areas to ensure that they would not be overgrazed.

Invertebrate conservation is not always glamorous or the stuff of headlines. Much of the work takes concentrated effort over periods of years, with progress made in small steps. Through the ISSSSP, the U.S. Forest Service and the BLM are taking a proactive role in recognizing and conserving the true diversity of animals on land in their care.

An important part of the ISSSSP's work is building the expertise of agency staff. Xerces executive director Scott Hoffman Black (kneeling, with hat) leads a training workshop in butterfly identification and habitat management. Photograph by Pepper Trail.

INVERTEBRATE NOTES

New Books

Birds, mammals, amphibians, flowers, trees—these are all well represented in the world of field guides. As many of our readers know, invertebrates generally fare less well, although butterflies, dragonflies, and beetles have been featured in many books. Two new volumes help to give a couple of often-overlooked groups their due.

Fall can be a great time of year to observe spiders, and for those who live in North America, there is a beautiful new book to assist both arachnophiles and those new to spider identification. *Common Spiders of North America* (University of California Press), written by Richard A. Bradley and illustrated by Steve Buchanan, is the first comprehensive guide to North America's sixty-eight spider families, providing an enjoyable introduction to spider biology, natural history, collection, and identification. With beautiful illustrations of 469 of the most commonly found species, and an easy-to-follow introduction to spider biology and anatomy, it is sure to engage a variety of readers.

A Field Guide to the Ants of New England (Yale University Press) by Aaron M. Ellison, Nicholas J. Gotelli, Elizabeth J. Farnsworth, and Gary D. Alpert may be the first user-friendly regional guide to these familiar but underappreciated creatures. The guide covers New England's five ecoregions: the Eastern Great Lakes Lowlands, the Acadian Plains and Hills, the Northeastern Highlands, the Northeastern Coastal Zone, and the Atlantic Coastal Pine Barrens. With more than five hundred line drawings, three hundred photographs, and many regional maps, this volume explores 143 of the region's ant species and should prove fascinating to novices and experts alike. With so few ant guides available, even people who live outside of New England will no doubt find the keys in this book to be useful.

Giant Squid Filmed in Natural Habitat

A creature that has captured imaginations for centuries became a little less mysterious when the Discovery Channel released the first-ever video footage of a giant squid in its natural habitat earlier this year. In 2012, a team of researchers, led by Tsunemi Kubodera of Japan's National Museum of Nature and Science, and Edith Widder, of the Florida-based Ocean Research and Conservation Association, encountered several of the leviathans in deep water off Japan's Ogasawara archipelago. Using innovative—and some might say, sneaky—techniques, they captured high-definition video of a squid in full attack behavior. Throughout the expedition, the team used extremely low-light techniques, employing infrared light and lures that mimicked bioluminescent signals. Generally, researchers have used bright lights when exploring

the depths. In addition to the excitement of finding the giant squid, the team's new techniques may help change the way that we explore the seas.

Video of the encounter can be viewed at http://dsc.discovery.com/tv-shows/curiosity/videos/first-video-of-a-giant-squid.htm.

Losing Just One Bee Species Harms Plants

A study by two U. S. researchers showed that removing one bee species from an ecosystem can negatively impact plant reproduction, contradicting the theory that decreasing bee numbers will not affect plant reproduction until most pollinator species have disappeared. The researchers temporarily removed the most populous bumble bee species from a Colorado meadow, then measured seed production of *Delphinium barbeyi*, a type of larkspur; each flower produced, on average, one-third fewer seeds.

When researchers captured bees visiting the larkspur flowers, they found that the bees carried a broader variety of pollen—most of which was not useful to the larkspur. Researchers posit that with fewer pollinators in the meadow, the remaining species were less picky and visited a broader variety of plant species. (Brosi, B. J., and H. M. Briggs. 2013. Single pollinator species losses reduce floral fidelity and plant reproductive function. *Proceedings of the National Academy of Sciences* 110:13044–13048.)

European Grassland Butterflies in Decline

Worrying declines in Europe's butterflies were uncovered by a recent study. Common blue (*Polyommatus icarus*), photographed by L. B. Tettenborn.

Europe's grassland butterfly populations declined by almost 50 percent between 1990 and 2011, according to a recent report by the European Environment Agency. The study tracked seventeen species in nineteen countries across Europe over two decades. The EEA cites changes in rural land use—specifically, intensifying agriculture in some areas and land abandonment in others—as the primary factors driving the loss and degradation of butterfly habitat.

Butterflies can act as indicators of general ecosystem health, and a decline in their populations signals significant problems with the health of Europe's grassland ecosystems. (van Swaay, C., et al. 2013. *The European Grassland Butterfly Indicator: 1990–2011* [EEA Technical Report 11/2013]. 36 pp. Copenhagen: European Environment Agency.)

STAFF PROFILE

Megan Faria, Financial Manager

How did you first hear of the Xerces Society? I attended a presentation given by Mace Vaughan, Xerces' pollinator program director, in 2005, about the importance of pollinators and ways to create pollinator habitat in your yard. Soon after that, I participated in a few bee-block building parties and learned a lot about native plants. Little did I know that a few years later I would be working for Xerces.

What's the best thing about your job? The people and the spreadsheets. Two very different things, but I enjoy both. The staff is incredibly smart and proactive, the work environment is supportive, and the spreadsheets keep it all organized. Also, our main office is located in one of the best cities! Portland is a terrific place to live, work, and play. I have fun riding my bike around the city for transportation, partaking in community events, and exploring the many surrounding natural areas.

What do you do to relax? I like seeing live theatrical shows. I have a background in dance and theatre and I support the performing arts—and participate in them when I have the time. Right now, I'm rehearsing for a modern dance production that will debut in January 2014. The rehearsal process is not very relaxing, actually, but it's a lot of fun to use my creative side and collaborate with other dancers. I also enjoy spending time with friends and family, going to the beach, hiking in the woods, and reading the latest best-seller.

Who is (or was) your environmental hero? Sandy Diedrich, founder of Portland's No Ivy League, sparked my interest in habitat conservation. I remember watching a program on television, shortly after I arrived in Portland in 2001, in which Sandy drove around in her van, pointing out places where the ivy was taking over—a big problem in the Pacific Northwest—and helping to educate the public as to what could be done about it.

This got me to look more closely at the landscape around me, and inspired my interest in biodiversity and environmental restoration and preservation.

Where were you educated? I attended the University of Utah, in Salt Lake City, where I received a BFA in ballet. Later, after moving to Portland, I studied accounting and finance at Portland Community College.

Ten Thousand Acres Spared from Mosquito Spraying

With the help of organic farmers, cranberry growers, beekeepers, and other concerned citizens, the Xerces Society recently stopped a plan to spray the insecticide Dibrom over ten thousand acres of homes, forests, and recreation land around Oregon's Bandon Marsh National Wildlife Refuge. Dibrom is highly toxic to a variety of beneficial insects, including bees and butterflies. It is also toxic to birds and fish that use the refuge, and it is considered toxic to humans.

The misguided plan was an attempt to control the salt marsh mosquitoes that breed at the refuge. A recent tidal marsh restoration project had led to an increase in mosquitoes and, subsequently, complaints from citizens living nearby. Under pressure from the Bandon City Council and Coos County commissioners, the refuge decided to declare an "emergency" and dodge environmental review requirements, despite the Coos County Health Department's determination that the mosquitoes posed no public health risk.

Xerces Society scientists first wrote to the U.S. Fish and Wildlife Service demanding that the plan be stopped. Xer-

The Xerces Society joined forces with a broad range of concerned citizens to prevent aerial spraying on ten thousand acres of land around Bandon Marsh National Wildlife Refuge. Photograph courtesy of David Pitkin, USFWS.

ces staff then worked with local citizens in organizing opposition to the spraying and rallying community members to attend a town hall-style public meeting held by Coos County. Xerces' actions helped to catalyze local opposition to the spraying and the town hall meeting was packed with residents, three-quarters of whom opposed the spraying plan. In response Coos County commissioners canceled the aerial spraying two days later.

Our task is not finished, however. Although the aerial spraying was stopped, three hundred acres of the refuge were treated with MetaLarv, a granular insecticide that is highly toxic to a variety of aquatic life. We will continue to push the Fish and Wildlife Service and Coos County to develop a scientifically sound Integrated Pest Management plan for mosquitoes at the marsh. An IPM-based plan treating only those areas in which mosquitoes breed will provide effective control of the mosquitoes, bring relief to local residents, and give wildlife the refuge they deserve.

This action represents the first time our recently released report, *Ecologically Sound Mosquito Management in Wetlands*, has been used in support of public advocacy. Until now, its influence has been limited to closed-door meetings. The campaign against the Bandon Marsh spraying gave it a very public—and successful—airing.

Working to Reduce the Impacts of Neonicotinoid Insecticides

A drama unfurled in a Portland, Oregon, suburb in June of this year. Thousands of dead and dying bumble bees carpeted the tarmac below the linden trees that lined the parking lot of a big-box store. Xerces scientists responded to telephone calls from concerned citizens and after visiting the parking lot, reported the incident to the Oregon Department of Agriculture. Linden is highly attractive to bees and on rare occasions its nectar can be toxic, but could this many dead bees be a natural phenomenon?

Investigators from the Oregon Department of Agriculture provided the answer: No. Their laboratory tests demonstrated that the deaths were caused by dinotefuran, an insecticide applied to the trees to control aphids, whose honeydew had been dripping on cars below. An estimated fifty thousand bumble bees died on those fifty-five trees.

This incident received a great deal of media coverage in newspapers and on television and radio in Oregon and further afield, in part because it occurred during National Pollinator Week. In another unfortunate coincidence, the product applied to the linden trees, Safari, is manufactured by a company that sponsors National Pollinator Week.

Dinotefuran is one of a group of insecticides called neonicotinoids. These are systemic insecticides, meaning they are absorbed into plants. They are very long-lasting, and because they make nectar and pollen poisonous—as this incident illustrates—they can be highly toxic to bees. Neonicotinoids are implicated in bee die-offs the world over. The European Union has banned certain uses of these chemicals for the next two years due to risks to pollinators.

Sadly, as is often the case, it takes a tragedy to push change forward. Progress to prevent future bee kills has been

made since June. The Oregon Department of Agriculture declared a 180-day ban on the use of dinotefuran in the state, and at a national level, the Saving America's Pollinators Act was introduced in the U.S. Congress. This act suspends certain uses of neonicotinoids, providing a time-out for these insecticides until the Environmental Protection Agency (which regulates pesticide use in the United States) can determine whether they are safe to use on crops that are visited by bees. Xerces scientists helped write the Act, which Representatives Earl Blumenauer and John Conyers introduced in Congress in July.

Although the Wilsonville incident shone the spotlight on neonicotinoids and bees, it should come as no surprise that products designed to persist inside plants for long periods have multiple impacts. A new report from the Xerces Society highlights the risks that neonicotinoids pose to other beneficial invertebrates like earthworms and lady beetles. *Beyond the Birds and the Bees* provides a comprehensive review of published articles and pulls together the growing body of research that demonstrates risks from neonicotinoids to these beneficial animals. These risks occur particularly in agricultural systems, but are also present in urban and suburban ornamental landscapes.

Although less charismatic than bees, beneficial insects like beetles and wasps play critical roles in healthy, functioning ecosystems. For example, predatory and parasitic insects and other arthropods provide natural pest suppression to farms—an ecosystem service conservatively valued at more than $4.5 billion annually in the United States—as well as to natural areas and developed landscapes.

In urban areas, pesticides are used primarily for cosmetic purposes: to have a weed-free lawn, a blemish-free rose, or an aphid-free linden tree. The risk of losing valuable pollinators and predators of pest species far outweighs any benefit from this type of use. You can take simple steps to reduce the threat from neonicotinoids: Check your own garage or garden shed for neonicotinoid products, and stop using them. For more information, see the Xerces brochure *Protecting Bees from Neonicotinoid Insecticides in Your Garden*.

Neonicotinoids are now the most widely used group of insecticides in the world. Since their initial registration in the mid-1990s, neonicotinoids have been promoted as low-risk chemicals, with low impact on human health, low toxicity to nontarget organisms, lower application rates, and compatibility with Integrated Pest Management.

Unfortunately, the many studies completed since these compounds were first used have not borne out the validity of these assumptions.

For more information about our efforts to protect insects from neonicotinoids or to download copies of our new brochure or reports, please visit our pesticide program webpage, www.xerces.org/pesticides.

Whole Foods Market Shares the Buzz

This summer, Whole Foods Market and its vendor companies launched the "Share the Buzz" campaign for a second year, demonstrating their continuing concern about and support for pollinators. And, for the second year, they teamed up with the Xerces Society to promote awareness of and engagement in pollinator conservation.

Whole Foods Market stores across the United States held events and mounted special displays to promote this campaign, but the most remarkable action was taken by a store in Rhode Island. Staff of the University Heights store removed pollinator-dependent items from the produce department. The resulting bare shelves and limited choice were a vivid illustration of how pollinators touch our lives each day.

As part of the Share the Buzz campaign, for a two-week period (June 12 to 25), Whole Foods stores nationwide donated ten cents to the Xerces Society for each pound of organic summer squash sold. A huge amount went out the door and Xerces received nearly $30,000. This money directly supports our work with farmers across the country, helping them to restore wildflower-rich native habitat and protect local biodiversity.

In addition, Whole Foods Market raised donations from their vendor companies to help sustain our bee-conservation efforts nationwide. Our thanks go to Mrs. Meyer's Clean Day; the Hain Celestial Group, Inc. (through their brands MaraNatha, Westsoy, Terra Chips, and Arrowhead Mills); Attune Foods; Cuties; Kashi; SweetLeaf; Muir Glen; Talenti; So Delicious; and Udi's for their immense generosity.

Whole Foods Market launched its 2013 "Share the Buzz" campaign in June. Photograph by Matthew Shepherd.

Pollinator Conservation Outreach in India

After five years of presenting pollinator short courses across much of the United States, we've now reached a new continent! Eric Lee-Mäder, assistant director of Xerces' pollinator conservation program, was invited to present a three-day pollinator short course at Tamil Nadu Agricultural University in Coimbatore, India. More than thirty leading researchers and conservationists from across India attended the short course.

During the three days of lectures and field visits, participants attended sessions on habitat restoration for pollinators, pesticide reduction strategies, stingless beekeeping, and surveying pollinator populations in bee-dependent crop systems. We thank all of our partners and participants for their generous hospitality and enthusiasm, especially Drs. B. A. Daniel (Zoo Outreach) and M. R. Srinivasan (TNAU), who spearheaded the event planning. We are working with Zoo Outreach and the newly formed India Pollinator Network to explore next steps in helping to expand the adoption of pollinator conservation practices across India.

Eric Lee-Mäder (center), assistant director of Xerces' pollinator program, talks with two participants at the pollinator conservation short course he led in India. Photograph courtesy Tamil Nadu Agricultural University.

Project Bumble Bee

The year 2013 has been a good one for the Xerces Society's Project Bumble Bee, which works to raise awareness of declining bumble bees and increase conservation efforts to protect them and their habitat. In addition to formally requesting the U. S. Fish and Wildlife Service to protect the rusty patched bumble

bee under the Endangered Species Act (reported in the last issue of *Wings*), we have also produced and distributed a beautifully illustrated brochure that gives an introduction to managing habitat with bumble bees in mind. *Bumble Bee Conservation: A Guide to Protecting Our Vital Pollinators* is a companion to our comprehensive conservation guidelines, *Conserving Bumble Bees*.

A major part of the work of Project Bumble Bee is recruiting and coordinating citizen scientists who can scour their local area and report sightings of a trio of target species: the rusty patched, yellow-banded, and western bumble bees. Over the past few years, reports from citizen scientists have provided essential data on the distribution of these species, which has enabled our scientists to advocate for protection and focus conservation efforts on key areas. This year has produced a bumper crop of citizen-science sightings: eighty-two records of our target species have been confirmed from all over North America. Thank you to the volunteers who dedicated countless hours to finding and reporting these sightings.

The search for these focal species is not solely the domain of citizen scientists. Thanks to the Oregon Zoo Foundation's Future for Wildlife program, Xerces' conservation biologist Rich Hatfield was able to hunt for the western bumble bee on the slopes of Oregon's Mount Hood this summer. Rich found several individual bees in locations throughout the Mt. Hood National Forest. This is likely one of the westernmost strongholds for this species in the state. The Oregon Zoo sent a videographer to document the surveys; the resulting three-minute video gives an excellent overview of the project and includes some wonderful images of bumble bees.

To view the video or to find out more about our citizen-science activities, please visit the webpage www.xerces.org/bumblebees/.

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For information about membership and our conservation programs for native pollinators, endangered species, and aquatic invertebrates, contact us:

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Most North American native bees are solitary, although they do aggregate to nest and, as shown here, to sleep. Male bees don't make nests, so they sleep on vegetation. These digger bees (*Anthophora californica*) hold on with their mandibles as they rest. Photograph by Rollin Coville.

The Xerces Society for Invertebrate Conservation

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On the cover: Pollinators are a core component of all terrestrial ecosystems. Designing habitat restoration and management plans to meet the needs of bees and other pollinators provides a sound foundation for a diverse environment that sustains a myriad of other wildlife. Leafcutter bee (genus *Megachile*), photographed by Mace Vaughan.