WINGS

ESSAYS ON INVERTEBRATE CONSERVATION

THE XERCES SOCIETY SPRING 2012

CONTENTS

Introduction: Life on the Edge

Scott Hoffman Black

"Endangered." "Threatened." "Critically imperiled." "At-risk." These are all terms we use to describe the plight of declining species, but what insight do they give us about conserving the animals that most need protection? The essays in this issue of *Wings* include stories of conservation success, nationwide citizen action, and dogged sleuthing, all in the cause of protecting invertebrates.

We start with Mitchell Magdich sharing his story of returning the Karner blue butterfly to Ohio. Sarina Jepsen then introduces us to the world of at-risk bumble bees, in particular the ongoing efforts to understand why several species are in steep decline in the United States, and to find ways to stop it.

In our third essay, Sarah Foltz Jordan relates why and how she became a conservation detective, gathering information necessary for effective conservation action by federal agencies in Oregon and Washington. From the Pacific Northwest we travel to Hawaii, where Karl Magnacca fills us in on efforts on behalf of the islands' native yellow-faced bees. Last, I write about insects and the Endangered Species Act, the only national law in the United States that specifically protects imperiled insects and their habitats.

Our hope is to provide a deeper understanding of the range of efforts dedicated to the preservation of rare invertebrates, and to inspire greater action to save animals living on the edge.

The Delhi Sands flower-loving fly (*Raphiomidas terminatus abdominalis*) is the only protected fly in the continental United States. It is found in a small region centered on the city of Colton, California. Photograph by Guy Bruyea.

Summertime Blues

Mitchell Magdich

On a warm, sunny, June morning in 1940, Homer Price played hooky from his farm chores. He intended to spy out and, he hoped, collect a few of the rarer butterflies that he'd seen in past years in an area now known as the Oak Openings, in Lucas County, Ohio. Homer was particularly fond of the sand dunes there, where he had spotted dozens of diminutive Scudder's blue butterflies the previous season. He would love to add one of the gorgeous, bright-blue males to his collection, and this would be a perfect day to net a fresh adult in mint condition.

When Homer arrived, lupine, the host plant of the Scudder's blue, was in full bloom, and the landscape leading up to the nearly naked sand dunes was thick with amethyst-colored blossoms. Homer stepped ever so cautiously through the lupine, his eyes feasting on dozens of Scudder's blues on the wing. He spotted a fresh-looking male taking nectar from a blossom just a foot or two away and, with a quick flash of the net, he had his prize. Homer netted two more males and two females that morning, before heading home.

Skip forward half a century to a cold, cloudy, February day in 1991. A relatively new employee at the Toledo Zoo, I had recently discovered a treasure trove of well-preserved butterflies hidden away in the bowels of the zoo's Museum of Science. As an enthusiast of rare local butterflies, I was elated at the prospect that the zoo's collection might include the rarest of Ohio's rare species, such as the frosted elfin (*Callophrys irus*), Persius duskywing (*Erynnis persius*), or Dorcas copper (*Lycaena dorcas*). I was especially interested in the possibility of finding a Karner blue in the collection, a species to which I'm particularly attached. As I went through dozens of specimen drawers, I found one labeled "Lycaenidae" (the family to which the Karner blue belongs) and quickly pulled it out, anxious to view the contents. There were about two dozen blues of various species in the drawer. Five drew my attention because of their unusual labels: "*Lycaena scudderi*, Luc. Co., Jun. 1940." I popped the lid of the drawer to get a closer look. They looked like Karner blues to me—three males and two females.

And then I remembered. It had not been until l944 that Vladimir Nabokov described *Lycaeides melissa samuelis*, a change necessitated in part because Nabokov concluded that the name "*scudderi*" properly belonged to a different species, so it made sense that I wouldn't find labels identifying Karner blues among this collection from four years earlier. Now, seeing these specimens from 1940 brought all sorts of images to mind. I instantly pictured Homer Price, one of the more prominent butterfly collectors in northwest Ohio from the late 1930s through the mid-1960s. I had once seen a photograph of him, wearing bib overalls and holding a homemade butterfly net with a hoop

The Karner blue (*Plebejus melissa samuelis*) is distributed from Wisconsin to the Atlantic, but there are many areas within that range from which it has disappeared. Photograph by Doug Taron.

at least four feet in diameter. It seems a bit comical to imagine such a large net being used to capture a butterfly as petite as the Karner blue. There were probably occasions when, with his large net, Homer could have captured a dozen or more Karner blues in a single swing.

Tragically, times have changed. The Karner blue had been extirpated from Ohio, a victim of habitat loss, degradation, and fragmentation. With a dedicated group of volunteers I had spent the spring and summer of 1988 looking for Karner blue populations in northwest Ohio. We traipsed nearly every lupine patch in the county to find only three males. That was the last year in which a native Karner blue was seen in the state.

Little did I know that my coming to the Toledo Zoo would help to bring about a change in fortune for the Karner blue in Ohio. Shortly after starting work there, I struck up a friendship with Dr. Peter Tolson, the director of conservation and research. Peter was interested in getting the zoo more involved in local conservation efforts, and, because I had previously worked with Toledo Metroparks and the Ohio Department of Natural Resources (DNR) on local butterfly conservation projects, my arrival was fortuitous. I took Peter on a tour around the Oak Openings, the most biologically diverse habitat in Ohio, and home to more rare species of flora and fauna than any other region of the state. Peter was captivated by the story of the Karner blue in Ohio, and with the addition of a trip to Michigan to see Karners on the wing, he was hooked.

Work began in earnest in 1992, when, with a small grant from the DNR Division of Natural Areas and Preserves, the Ohio Karner Blue Butterfly Recovery

Team was formed. The team comprised representatives of several nonprofit organizations and government agencies, with each organization agreeing to a specific role. The purchase and restoration of potential release sites was undertaken by the Nature Conservancy, Toledo Metroparks, and Ohio DNR. Michigan DNR allowed site access for collecting breeding stock. The necessary federal permits were provided by the U.S. Fish and Wildlife Service, and state permits by Michigan and Ohio DNRs; Ohio DNR also provided project oversight. Technical assistance came from the USFWS and Ohio Lepidopterists. The Toledo Zoo was responsible for developing captive breeding and husbandry techniques, propagating lupine, and conducting habitat analysis.

The team decided that the first reintroduction would take place at the Nature Conservancy's Kitty Todd Preserve outside Swanton, Ohio. Kitty Todd was the site of the last recorded population of the Karner blue in Ohio before it winked out in 1988, and most of the critical elements for reintroducing the butterfly were still in place, including a sprinkling of wild lupine and nectar plants. Intensive habitat management by Nature Conservancy staff over the next several years dramatically increased the number and density of the lupine and nectar plants and set the stage for the reintroduction.

At the Toledo Zoo, with several small grants from Ohio DNR, we built a polyethylene greenhouse to pilot the production of wild lupine (*Lupinus perennis*) from seed. Since its first crop in 1993, the zoo has successfully grown thousands of plants, an important component of both the captive breeding program and

A male Karner blue on perennial lupine (*Lupinus perennis*), the only plant its caterpillars will eat. Photograph by Carly Voight.

the habitat restoration. Parallel to this, Peter and I spent several years working with a surrogate species, the Melissa blue (*Lycaeides melissa melissa*) to refine our captive breeding protocols, rearing this species through several generations.

Our most intensive efforts came in 1996 and 1997, when we conducted an analysis of both the habitat at Kitty Todd as it was being restored and occupied habitat at existing Karner blue sites in Michigan. Over two field seasons, we measured the abundance and density of both host and nectar plants during the Karner blue's two flight periods—late May through early June and early to late July. We compared data from Kitty Todd with that from Michigan's occupied sites, using this analysis to inform the restoration project as it was taking place. If our enhanced habitats compared well with the reference sites, it would serve as a good predictor for a successful reintroduction. The news was good. Several of the restored sites at Kitty Todd compared favorably with several of the Michigan sites occupied by Karner blues.

By the spring of 1998 all of the heavy lifting was done. Lupine plants were growing, the restorations were well underway, the habitat analysis was complete, captive breeding techniques had been devised, and the permits were all in place. On a beautiful day in late May, Peter and I, accompanied by a contingent from the recovery team, headed to the Allegan State Game Area in Michigan to collect the founders for the captive breeding program. We netted twenty-six female Karner blues, and sequestered each one in its own plastic box, fitted with a vial and a cotton wick saturated with a sugar solution, for transport to Toledo. The plastic boxes were packed in a cooler; the chill and darkness would keep the adults inactive during the three-hour trip.

Back at the zoo, each female was placed on a lush lupine plant growing in a two-gallon container. The vial of sugar solution was placed in the soil, and the whole container covered with a net. After a day or two the females began to lay their eggs on the lupine. Once the eggs hatched, the real work began. Growing larvae can consume huge amounts of lupine, especially in the late instars (growth stages). The captive larvae were checked daily and moved to fresh plants as needed. When the larvae reached the last instar, a bark chip was placed on the soil surface of the container to provide a place for them to hide during pupation.

In early July, within two months of the butterflies' arrival, dozens of pupae were darkening, indicating that the adults would soon be eclosing (emerging). The males emerged first, followed a few days later by the females. They were cared for at the zoo until a few dozen adults were ready for release, then carefully transferred to a net enclosure for transport to Kitty Todd. At the preserve, Peter and I were followed by a throng of media and agency officials as we journeyed the final half mile to the designated release site. With everyone primed and ready, the enclosure was opened and the Karner blue butterfly was on the wing in Ohio for the first time in ten years. The dream was realized.

That first year we released 276 adult Karner blues. Much has happened since. A project coordinator, Candee Ellsworth, was hired by the zoo to oversee the Karner blue captive breeding program. A new state-of-the-art butterfly conservation facility was built on zoo

Successful reintroduction of the Karner blue to Ohio was possible only with careful planning and habitat restoration. Photograph by Mitchell Magdich.

grounds, allowing the public to see the operation firsthand. Under Candee's direction and with continued refinement of our captive breeding strategies and the aid of the new facility, production has more than doubled—and more than 8,150 Karner blue butterflies have now been released at five locations in northwest Ohio and southeast Michigan.

We have had our setbacks too, of course. In 2006, for instance, a late May freeze nearly wiped out that season's cohort not long after it was released. But hundreds of acres of Karner blue habitat have been restored or acquired, and reproduction and dispersal have continued. The most exciting development in the last few years has been the dispersal of Karner blues to restored habitat nearly a mile away from one of the previous release sites, and that population appears to be thriving. Although the Oak Openings is far different today from what Homer Price experienced on that beautiful day in June 1940, one thing is certain: The Karner blue is back in Ohio. I think Homer would be very pleased.

Mitchell Magdich, a conservation biologist engaged in protection of endangered butterflies, is curator of education at the Toledo Zoo. *He would like to acknowledge the members of the Ohio Karner Blue Butterfly Recovery Team, whose commitment made the reintroduction of the Karner blue to Ohio a reality. In particular, Dr. Peter Tolson has been tireless in his efforts to conserve endangered butterflies. Candee Ellsworth, conservation coordinator at the Toledo Zoo, has played an essential role in the Karner blue captive breeding effort.*

The Silence of the Bees

Sarina Jepsen

The gap between trees in which Dr. Robbin Thorp stood on the slopes of Oregon's Mt. Ashland may not have resembled the "bee-loud glade" envisioned by Wiliam Butler Yeats in *The Isle of Innisfree*, but it was humming with bees. Dr. Thorp was keenly aware of the bumble bees moving from flower to flower, but maybe more so of the bumble bees that were not. This sunny spot was the last place Thorp had seen Franklin's bumble bee (*Bombus franklini*) in a previous year's visit, making him possibly the last person to see this bee alive. After a career working on crop pollination at UC Davis, in retirement Dr. Thorp focused more on native bees and their conservation. In 1998, he began yearly surveys of the bumble bee community in the Siskiyou Mountains of southern Oregon, and, within just a few years, had witnessed a dramatic decline in two species, Franklin's bumble bee and the western bumble bee (*B. occidentalis*). Franklin's bumble bee has one of the smallest distributions of any bumble bee in the world, but the western bumble bee was formerly a very common and widespread species, so much so that it had even been domesticated and used as a commercial pollinator.

Actually, the use of the western bumble bee as a commercial pollinator may well have been a major factor responsible for its decline, as well as that of Franklin's bumble bee. Around the same time that Dr. Thorp noticed the populations of these two western species plummeting, the commercial bumble bee industry reported that there had been an outbreak of the fungal pathogen *Nosema bombi* in laboratory colonies of the western bumble bee, and the companies eventually discontinued production of this species. Prior to this, in the early 1990s, North American bumble bees had been sent to Europe to prepare them for domestication. When the bees were shipped back, they may have brought with them pathogens acquired from European bees.

A rusty-patched bumble bee (*Bombus affinis*), found and photographed by Jen Knutson, one of hundreds of citizen scientists who searched for this rare bee.

In light of these events, Dr. Thorp hypothesized that an exotic pathogen had spread from commercial bumble bees, wreaking havoc on the wild populations. His hypothesis is supported by the timing, speed, and severity of the declines seen in the two western species, and also in two closely related eastern species, the rusty-patched bumble bee (*B. affinis*) and the yellow-banded bumble bee (*B. terricola*). According to a recent study led by Dr. Sydney Cameron of the University of Illinois at Urbana-Champaign, the ranges of these two species have contracted by an estimated 87 percent and 31 percent, respectively. Dr. Cameron also has found that declining species of bumble bees collected in the wild have higher rates of *Nosema bombi* and lower genetic diversity than species of bumble bees that aren't declining.

The reason for domestication of bumble bees is primarily to pollinate greenhouse tomatoes, replacing the more cost-intensive hand pollination. Bumble bees are used because of their ability to "buzz-pollinate," a fascinating behavior in which the bee disengages her wings from her flight muscles and then vibrates those muscles, causing her body to quiver and thereby shake the pollen loose from the tomato flower; without the vibration, the pollen would remain in the anther. You can actually hear a buzzing sound when she does this. The year-round availability of beautiful tomatoes in the supermarket is a relatively new phenomenon, and the rise of this industry is intimately linked to the increased use of commercial bumble bees. (Honey bees cannot buzz-pollinate.) Commercial bumble bees are also being used with increasing regularity for the pollination of blueberries, cranberries, peppers, and a variety of other fruit and vegetable crops.

Initially, two bumble bees were commercially available in the United States, each in its native range: the western bumble bee in the western states, and the common eastern bumble bee (*B. impatiens*) east of the Rockies. For a time, the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) had a policy of not allowing bumble bees to be shipped outside their native ranges. This policy was based on a risk assessment conducted in 1993, which concluded that releasing the common eastern bumble bee in the western United States would pose a significant risk to wild bumble bees because the eastern bees might compete with, and perhaps eliminate, western species. APHIS also found that exotic diseases might be introduced.

But when disease problems caused commercial breeders to abandon production of the western bumble bee, APHIS disregarded its own risk assessment and began allowing eastern bumble bees to be shipped to the western United States. In issuing permits to introduce an exotic species into a new area without evaluating the environmental impacts, APHIS was in violation of the National Environmental Policy Act. Perhaps to address this situation, APHIS decided in 1998 to stop regulating commercial bumble bees altogether, and left the matter up to individual states. (APHIS representatives have since stated that their agency never actually had the legal authority to regulate bumble bees.) Since then, only Oregon has developed regulations to prohibit nonnative bumble bees from being shipped into the state. The California Environmental

The yellow-banded bumble bee (*Bombus terricola*) was previously common from the Upper Midwest to the Atlantic. Photograph by Leif Richardson.

Quality Act stipulates that commercial bumble bees can be used only in greenhouses, and not for the pollination of open-field crops. All other western states allow shipments of eastern bumble bees to enter without any restrictions.

As I learned more about the lack of regulations covering the movement of bumble bees, I became concerned about the many potential risks that this growing industry poses to wild bumble bees throughout the world. Not only are nonnative commercial bumble bees from the eastern United States shipped to most western states without restriction, but the European buff-tailed bumble bee (*B. terrestris*) has been introduced to more than ten countries and in many cases has quickly spread away from the farms where it was used. Nonnative bumble bees are already established in Argentina, Chile, Israel, Japan, Tasmania, and New Zealand, and nonnative bumble bees have been observed in the wild in Australia, Mexico, and Canada. As commercial bumble bees are introduced into new areas, pathogens and parasites—which scientists are just beginning to identify and understand—likely come with them. In Japan, for instance, the commercial use of bumble bees has led to infestation of wild bumble bees there with nonnative mites.

Grappling with the decline of many species of North American bumble bees, I set out to examine whether APHIS has the legal authority to regulate their movement. Lori Ann Burd, at the time a recent graduate of Lewis & Clark Law School, in Portland, Oregon, joined me in this effort, and together we determined that APHIS does in fact have clear authority under the Plant Protection Act—and potentially under two other statutes—to regulate commercial bumble bees within the United States.

The common eastern bumble bee (*Bombus impatiens*) is commercially reared and sold as a crop pollinator. Photograph by David Morrison.

We developed a petition outlining this authority and asking APHIS to disallow the shipping of bumble bees outside their native ranges and to require that any bumble bees being moved within their native ranges be certified as disease-free. The petition was submitted in January 2010 by the Xerces Society, Dr. Thorp, the Defenders of Wildlife, and the Natural Resources Defense Council. More than sixty scientists signed a letter in support of our petition, including many of the world's leading bumble bee researchers.

Following submission of the petition, the Xerces Society helped to organize an international meeting at the Saint Louis Zoo in November 2010 to develop a conservation strategy for North America's bumble bees. A representative of APHIS attended that meeting and stated publicly that the agency indeed possesses the legal authority to regulate the movement and disease status of bumble bees under the Plant Protection Act. This was a dramatic change from their previous position, but, to date, APHIS still has not established any new regulations.

Although pathogens are one of the primary suspected causes of the decline of at least four species, North America's bumble bees are facing other threats, including habitat loss and fragmentation, the extensive use of pesticides, overgrazing, and climate change. The latter is already disrupting the delicately timed relationships of plants and their pollinators, and may pose a particular threat to the rich bumble bee fauna in alpine and sub-alpine habitats.

Perhaps one of the most significant threats to bumble bees is our lack of knowledge regarding their distribution, population status, and population trends. We became aware of the declines of the western and Franklin's bumble bees only because Dr. Thorp happened to be looking; his findings catalyzed action by the conservation and research communities.

To help fill the knowledge gap about North American bumble bees, Xerces has undertaken several projects in collaboration with Dr. Thorp, beginning in 2005 with the creation of Red List profiles for four species of bumble bee, followed in 2008 by a status review of three formerly common bumble bee species.

To document the distribution of the western, rusty-patched, and yellow-banded bumble bees, we established a

citizen monitoring program three years ago. Elaine Evans, now a doctoral student at the University of Minnesota, was instrumental in developing "wanted" posters and pocket-sized identification guides for the three species. More than a thousand people have contributed observations, resulting in more than forty confirmed records of these bees. Such citizen observations have greatly expanded our understanding of the current distribution of these imperiled species, providing information that is absolutely essential to their conservation.

On an international scale, we worked with Dr. Paul Williams of London's Natural History Museum and other scientists around the world to form the Bumblebee Specialist Group of the International Union for Conservation of Nature. The primary goal of this group is to complete a status assessment of the approximately 250 species of bumble bees worldwide.

In 2010, the Xerces Society filed a petition to list Franklin's bumble bee as endangered under the U.S. Endangered Species Act. In response to our petition, the U.S. Fish and Wildlife Service is undertaking a status review to determine whether Franklin's bumble bee will receive federal protection.

Dr. Thorp continues to visit the Siskiyou Mountains every summer to look for bumble bees. Although he hasn't recently found Franklin's bumble bee, last summer he found the western bumble bee in two different places, giving hope that—with the help of citizens and conservationists—bumble bees will weather the storm and continue to hum through our fields and meadows.

Sarina Jepsen directs Xerces' endangered species program and is deputy chair of the Bumblebee Specialist Group of the International Union for Conservation of Nature.

Franklin's bumble bee (*Bombus franklini*) was last seen on the slopes of Mt. Ashland, Oregon, in 2006. Photograph by Dr. Peter Schroeder.

Shedding Light on Little-Known Lives

Sarah Foltz Jordan

When I talk with my younger brother about my work at Xerces, he often acts confused. Lacking the "but, it's so precious!" mentality that I was born with, he wants to know what a tiny caddisfly that hardly anyone has even heard of is worth, and he asks what this seemingly insignificant animal does for us.

The answer, I tell him, is "plenty." Caddisflies recycle nutrients, provide critical food for fish and birds, and, as indicator species, alert us to pollution levels and habitat degradation in rivers and lakes. But that's not really the discussion I want to have. As entomologist-turned-philosopher Jeffrey Lockwood writes, "To ask what a life, human or insect, is 'good for' presumes that value lies in utility, and that worth is not intrinsic." In other words, the reason a rare invertebrate population should trump, say, a road-widening project, is not based on what these animals contribute to human existence, but rather is an acknowledgment that, here, in our midst, are unique and wonderful species, with longstanding relationships with their place.

The Puget blue (*Plebejus icarioides blackmorei*) is one example, a butterfly whose caterpillars are milked, not unlike cows, by industrious ants who carefully collect the larvae's sweet, nitrogen-rich "honeydew"—exudates—while simultaneously warding off dangerous parasitoid insects that are keen on laying eggs in the living caterpillars. There's the salmon coil (*Helicodiscus salmonaceus*), a timid, delicately coiled snail with blind, pigmentless eyestalks, which lives in

Ants tend caterpillars of the Puget blue (*Plebejus icarioides blackmorei*). The ants gather honeydew secreted by the caterpillars; in return, they protect the caterpillars from predators. Photograph by Caitlin LaBar.

Notwithstanding the presence of what appear to be eyestalks, the salmon coil (*Helicodiscus salmonaceus*) is sightless and must rely on other senses to understand its environment. Photograph by William Leonard.

dry, stony habitats, such as under rock piles, where it appears to rely entirely on touch, taste, and smell to gain information about its surroundings. And there's the Wahkeena Falls flightless stonefly (*Nanonemoura wahkeena*), confined to a single Oregon stream and so bizarre in a number of characteristics, including its abnormally long, grasshopper-like legs, that it has been assigned its own genus. This list could go on and on.

As development, agriculture, logging, and other activities continue to take their toll on the landscape, the responsibility to protect species like these—and the habitats in which they live—has never been greater. Here at Xerces, there is no shortage of rare invertebrates on our radar. The problem we face, then, is this: how do we allocate limited resources to the species most in need of, and most likely to benefit from, conservation efforts?

In the Pacific Northwest, a federal program known as ISSSSP (Interagency Special Status/Sensitive Species Program) is also concerned with these issues. A consortium of the Oregon and Washington regional offices of the U.S. Forest Service and the Bureau of Land Management (BLM), the ISSSSP seeks to improve the conservation and management of rare plant, fungal, and animal species. This program focuses on providing regional protection for federal "candidate" species and other rare species that meet agency criteria for inclusion on sensitive lists. Such criteria include documented occurrence on Forest Service or BLM land and sufficient rarity, decline, or habitat threat to cause the species to be designated by NatureServe and statewide National Heritage Programs as "critically imperiled," "imperiled," or "vulnerable." If these criteria are met, the agencies' land

To support conservation of the Coronis fritillary (*Speyeria coronis*), Xerces staff members gathered historic records and unpublished data, carried out surveys, and trained agency staff. Photograph by Bill Bouton.

managers are required to ensure appropriate protection for these species during land management activities.

For three years, the Xerces Society has worked with the ISSSSP's invertebrate sector, gathering information on Pacific Northwest invertebrates and helping to identify species of conservation concern. For the most part, our focus has been on what the ISSSSP calls "strategic" species, those that meet all but one criterion for being designated as "sensitive." Typically, these species are suspected to occur on Forest Service or BLM land in Washington or Oregon but are not yet documented there, which prevents them from being listed as sensitive and receiving the special treatment that goes along with that status.

Working as invertebrate detectives, we scour field guides and scientific journals, search online databases, visit museums to inspect the labels on historic specimens, and develop contacts with people who are attentive to each species. Fortunately, the Pacific Northwest is home to a large number of researchers, collectors, photographers, professors, graduate students, authors, land managers, museum curators, and agency staff members whose collective knowledge and amazing generosity have been invaluable to this work.

Gathering and mapping all known records enables us to delineate more accurately where a given species occurs, and to assess whether it is either documented or suspected to be present on Forest Service or BLM land. Finding records of a species on land managed by one of these agencies is often the final piece of the puzzle that allows the species to be classified as sensitive. Information is organized into species fact sheets that are distributed to agency biologists, and also made publicly available

on both the Xerces Society and ISSSSP websites.

Up to this point, Xerces' work with the ISSSSP has enabled us to gather extensive information on more than 150 Pacific Northwest invertebrates, enabling inventory, research, and monitoring for these animals to be prioritized. As a result, twenty-nine species have been reclassified as sensitive in one or both states and two species have moved from being without status to being classified as strategic. While these status changes might not sound like much, they are important drivers of species conservation on Forest Service and BLM land. A sensitive species must be evaluated when one of the agencies is developing a project—for timber operations or road construction, for instance—to determine the potential effect of the project on the species. Then, according to ISSSSP conservation planning coordinator Rob Huff, project plans might be re-worked in a variety of ways in order to reduce impacts on sensitive species or even potentially to benefit them. In contrast, if a species is not on the sensitive list, projects may occur without consideration of how such a species might be affected. Because many of these species are rare, threatened, or declining, yet have no federal or state protection, their status change is an opportunity for them to receive basic conservation consideration, albeit only on land managed by the BLM or the Forest Service.

For both strategic and sensitive species, targeted survey efforts can help establish abundance, status, and habitat requirements at known and new sites. Surveys can also be useful in detecting which species occur in areas proposed for logging or other land management activities. In an effort to assess the value of surveying the large number of species on which we have gathered data, we have developed a prioritization rubric to

The western ridged mussel (*Gonidea angulata*) has disappeared from many creeks, and work by the Xerces Society is helping to determine the extent of its decline. Photograph by Jayne Brim-Box, courtesy Confederated Tribes of the Umatilla Indian Reservation Mussel Project.

help determine where—and where not—to direct survey funding. Conservation need, habitat restriction, habitat threat, and likelihood of occurrence on BLM or Forest Service land are heavily weighted variables in this rubric, while ease of survey and ease of identification are weighted to a lesser degree. This tool has already been used to guide decisions.

Let's consider a few species. The Oregon giant earthworm (*Driloleirus macelfreshi*) is a worm Americans can be proud of. This pale whitish creature is one of the largest earthworms in the world—it can grow to well over four feet long!—and emits a peculiar, floral aroma when handled, giving rise to the genus name *Driloleirus*, "lily-like worm." This rarely encountered species was historically known from just fifteen sites in Oregon's Willamette Valley, where widespread conversion of land for agriculture, industry, and urban and suburban development has now eliminated much of the worms' suitable habitat. The establishment of nonnative earthworms poses further harm to this species, as the introduced worms not only compete with the native worms for food, but also raise the pH of the soil, lessening its suitability for the Oregon giant earthworm, which tends to thrive in more acidic earth. It's clear that this worm deserves a fairly high score in terms of conservation need. However, most known sightings were chance encounters decades ago, making it exceptionally difficult to conduct any systematic survey, so allocating energy and funding for surveying this species is not likely to be very rewarding. Accordingly, this species receives a low score in our rubric.

In contrast, Beller's ground beetle (*Agonum belleri*) scores high, making it one of fourteen sensitive or strategic species that have been funded for survey work. Although this beetle is relatively widespread, occurring from Washington's Puget Sound to northern Oregon, its sphagnum habitat has become extremely rare in the region, largely due to development and logging. Habitat loss is further exacerbated by the fact that this beetle is incapable of flight and can disperse to a new habitat only by walking—a difficult feat when suitable bogs are few and far between. High conservation need resulted in the selection of this species for attention. Surveys targeting this species and another bog-dependent beetle will take place this spring.

And so, what started out three years ago as little more than a list of names has been transformed into an organized compilation of information that can be used to evaluate the occurrence of these animals on federal lands, direct survey attention toward high-priority species, and provide rare species with basic conservation consideration on the national forest and BLM lands where they occur. We're hopeful that this work will continue to inform management decisions in the Pacific Northwest, and, ultimately, will help to increase the ability of rare species to hold their ground in a rapidly changing landscape—so that the ant may go on milking the caterpillar and the snail can continue creeping, blindly, under rock piles in the dark.

Sarah Foltz Jordan is a conservation associate for the endangered species program at the Xerces Society, where she works closely with the ISSSSP staff to gather information on rare, threatened invertebrates of the Pacific Northwest.

The Aloha Bees

Karl Magnacca

Of all the oceanic islands in the world—that is, those that have never been part of a continental landmass—the Hawaiian archipelago is unique in the way that its native flora and fauna have developed. The combination of geological age, diverse habitats, and extreme isolation (from continents and from other islands) has resulted in the evolution of more than six thousand species of native insects from only about 250 original colonists. With so little founding diversity represented, those few insects that did arrive in the islands evolved to take advantage of ecological opportunities. In the process, their groups often became much more species-rich than they are anywhere else.

For example, although predatory *Lispocephala* flies are found worldwide, there are more species in Hawaii than in the rest of the world combined. Similarly, the *Orthotylus* leaf bugs, a group of specialist plant feeders once thought to comprise only a handful of species, are now known to number more than a hundred. The *Hyposmocoma* case-making moths, members of an obscure and

The islands of Hawaii have only one genus of native bees, *Hylaeus*, and many species of Hawaiian *Hylaeus* are threatened by habitat destruction and other factors. *Hylaeus* in a flower of 'ulei (Hawaiian rose, *Osteomeles anthyllidifoli*), photographed by John Kaia, Malama Photography.

poorly known family, evidently evolved from one ancestor that colonized Hawaii into more than five hundred species that feed on everything from lichens on alpine rocks, to dead wood, to algae in flowing streams, to live snails.

The native bees of Hawaii are similarly intriguing. With sixty-two species of bees across the islands, the Hawaiian bees are not particularly diverse by global standards. By comparison, in the ecologically rather homogeneous town of Ithaca, New York, more than 250 bee species can be found in an area of only thirty-six square miles. But the type of diversity is strikingly different from one place to the other. Those species found in New York, as on any continent, come from a myriad of lineages, including six families and thirty-six genera, and most are more closely related to species found in distant areas than they are to those in the immediate vicinity. In Hawaii, by contrast, all sixty-two species have evolved recently from a single ancestor that arrived in the islands just a few million years ago.

These tiny bees are black, although most species have yellow markings, giving rise to their common name, "yellow-faced bees." *Hylaeus sphecodoides*, photographed by Karl Magnacca.

Furthermore, that one species arrival consisted of yellow-faced bees of the genus *Hylaeus*, one of a group of mostly small, inconspicuous bees in the family Colletidae that are found worldwide but are diverse only in Australia. As a result, there are more species of *Hylaeus* in Hawaii than there are in all of North America. As the only bees native to the islands, they adapted to occupy virtually every habitat, from the driest coastlines at the ocean's edge, to the wettest mountain rainforests where there is barely enough sun for them to forage, to alpine deserts above ten thousand feet where they visit flowers of the silversword plants and their relatives.

The Hawaiian bees are characterized by behavior that makes them unique among Colletidae. About a quarter of all of the world's bees are cleptoparasites ("cuckoo bees"); instead of visiting flowers and collecting pollen and nectar, they lay their eggs in the nests of other bee species. Their larvae then hatch and feed on the stored food, either killing the host eggs or larvae directly or causing them to starve. Cleptoparasitism has evolved multiple times within different families of bees but is absent from the family Colletidae—except in Hawaii, where a group of five related *Hylaeus* species has evolved this behavior.

As change came to the islands, first with the arrival of the Polynesian peo-

ple more than eight centuries ago and then accelerating dramatically following European contact in the late 1700s, Hawaii's native species, including its insects, were under pressure to adapt to new and changing environments. The islands' native plants, having evolved in isolation with no native mammals aside from one species of bat, and under conditions of relatively low natural fire frequency, lacked the genetic capacity to adapt to the alterations brought by humans.

Although fire has always been present due to lightning strikes and other natural phenomena, new plant species introduced by people—whether intentionally or accidentally—colonized burned areas more quickly than native species. Rats, followed by cattle, goats, pigs, and sheep, radically altered the vegetation, changing forests to grasslands and preventing reproduction of some of the most important native plants. Earthworms also have had a dramatic effect by changing the nutrient balance in forests and providing food for pigs, which dig up the ground and disrupt the lives of native species.

Still, throughout all of this upheaval, the bees have managed to persist. Although they are widespread—the great naturalist R. C. L. Perkins called them "almost the most ubiquitous of any Hawaiian insects"—the yellow-faced bees are relatively inconspicuous, and, after Perkins' work in the early 1900s, they were largely forgotten. Most people—including many biologists—don't realize that there are native bees in Hawaii, and the author of one paper in a major scientific journal even said, incorrectly, that all of them were extinct. Over the last decade, however, with an increased focus on pollinator conservation worldwide, the Hawaiian *Hylaeus* bees are finally starting to get the attention they deserve.

Yellow-faced bees in North America normally nest in hollow stems, but in Hawaii about a quarter of the species nest in the ground. *Hylaeus difficilis*, photographed by Karl Magnacca.

A comprehensive revision of the taxonomy of this remarkable group in 2003 described ten hitherto unrecognized species and provided an identification key for the first time, facilitating further investigation. Since then, studies of the Hawaiian bees have proliferated in several areas of ecology and conservation biology. Work is currently underway to look at pollen usage, pollination ecology, and the impact of such invasive species as ants and yellowjackets.

Unfortunately, not all is sunshine and roses for the bees. A conservation assessment in 2006 found that, mainly due to loss of habitat, nearly half of the species are at risk of extinction, including ten that have not been seen in more than eighty years and may be extinct already. While the numbers of protected sites and the area they include have both increased significantly over the last decade, the amount of funding for species protection has not. Recent cuts in

Loss of habitat has been a major reason for the declines in Hawaii's native bees. Squeezed between farmland and alien forest above and the ocean below, the tiny pale green patches of vegetation at the water's edge constitute the only known site for *Hylaeus psammobius*. Photograph by Forest and Kim Starr.

The role of bees as key pollinators of many of Hawaii's unique and rare plants is illustrated by the pollen grains coating this *Hylaeus*. Photograph by John Kaia, Malama Photography.

agricultural inspections, together with, since 2001, the diversion of inspectors to security rather than agriculture or natural resource protection, have resulted in increasing numbers of invasive species arriving in the islands. These invasives include predators that eat bees, as well as nonnative bees that compete for pollen and nectar.

Last year, following the submission of petitions by the Xerces Society, seven species (*Hylaeus anthracinus*, *H. assimulans*, *H. facilis*, *H. hilaris*, *H. kuakea*, *H. longiceps*, and *H. mana*) were listed as candidate endangered species under the Endangered Species Act. Although listing species as candidates does not guarantee them a better future, it is an important step in bringing about management action, particularly on the state and federal lands where most of these species are found.

In anticipation of the listings, the Hawaii Division of Forestry and Wildlife has been conducting a survey of the islands' rare bee populations, funded by the U. S. Department of Defense Legacy Resource Management Program. As the administrator of large areas of land on Oahu and Hawaii islands, and as overseer of some of the best remaining native habitats, the Department of Defense has both a legal and an ethical obligation to preserve the unique natural resources that exist within its jurisdiction. In addition, Army environmental field crews conduct a large portion of the endangered species management on state lands.

With collaborations such as this, in conjunction with other efforts by the Hawaiian conservation community, we hope to preserve the remarkable diversity of the Hawaiian bees.

Karl Magnacca is an entomologist with the Hawaii Division of Forestry and Wildlife. He has worked in insect evolution, ecology, and conservation biology in Hawaii since 1994, and has a special interest in the islands' Hylaeus.

Invertebrates and the Endangered Species Act

Scott Hoffman Black

As different as they are, the Karner blue butterfly, the American burying beetle, the Hines emerald dragonfly, and the Delhi Sands flower-loving fly share one thing in common: their conservation status has improved thanks to being listed under the U. S. Endangered Species Act. The ESA, passed by Congress in 1973 and signed by President Nixon in December of that year, has been described as the broadest and most powerful wildlife protection act in U. S. history. Before the ESA, federal laws aimed at preserving species applied only to vertebrates. Its passage extended coverage to all plants and invertebrate animals, the first time that insects received specific federal protection in the United States.

In his signing statement President Nixon underscored the fact that all varieties of wildlife are equally deserving of protection, declaring: "Nothing is more priceless and more worthy of preservation than the array of animal life with which our country has been blessed. It is a many-faceted treasure, of value to scholars, scientists, and nature lovers alike, and it forms a vital part of the heritage we all share as Americans."

The U. S. Fish and Wildlife Service immediately set about implementing the new mandate, and in 1974, its Office of Endangered Species employed Paul Opler as its first staff specialist in entomology. Dr. Opler's arrival provided official recognition to and responsibil-

In 1976 the Schaus swallowtail (*Heraclides [Papilio] aristodemus ponceanus*) was one of the first insects protected under the Endangered Species Act. Photograph by Bill Bouton.

ity for the conservation of rare insects, which resulted in quick action. By the next year, forty-one species and subspecies of insects were proposed for listing, and in 1976 the Bahama swallowtail (*Heraclides [Papilio] andraemon bonhotei*) and the Schaus swallowtail (*H. [P.] aristodemus ponceanus*) were officially designated as threatened. Listing of six California butterflies soon followed.

The central purpose of the ESA is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved." The power of the ESA to achieve this goal lies in its capacity to influence the actions of both public agencies and private parties, and it provides a number of ways for doing so. First, once a species has been listed as "threatened" or "endangered," the ESA can provide funds for habitat acquisition by federal agencies and for conservation efforts by individual states. In addition, the ESA requires critical habitat to be designated and recovery plans to be written for most listed species. The Act makes it illegal to take individuals of a listed species in the United States and its territorial waters. To "take" is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." (Limited taking of a species may occur, but only with a federal permit, and only for research purposes or as an unintentional or "incidental" result of other lawful activities.)

The ESA helps define who is responsible for implementing its powers, and requires the cooperation of all federal agencies in the conservation of any listed species whose habitats are found on land under their jurisdiction, or which might be affected by their actions or by actions funded or authorized by them. The Act also allows participation by the public in the determination of which species should be listed. Indeed, since 1980 most species that have been protected have been listed as a result of petitions brought forward by scientists, conservation groups, and other citizens.

The comprehensive protection provided by the ESA has not been universally supported. The Act has been both lauded and reviled, and its merits have been vigorously debated. The inclusion of insects and other invertebrates has been a particular source of contention. Invertebrate protection was weakened by a 1978 amendment that restricted the listing of distinct population segments to vertebrate animals. Not only did this lead to the loss of protection for the first insect that had been listed, the Bahama swallowtail—although its Florida population is at risk, it is just one of several populations across the swallowtail's Caribbean range—but it continues to affect which insects are eligible for listing.

The monarch butterfly (*Danaus plexippus*), for instance, is renowned for its long-distance migration to and from overwintering sites in Mexico. Most of the monarchs west of the Rocky Mountains, however, make a shorter journey to overwinter at various sites in coastal California. Even though this geographically distinct population has seen a more than 90 percent decline since the 1990s, it cannot receive protection because of the 1978 amendment; in contrast, the killer whale (*Orcinus orca*) is not protected as a species, but individual pods (family groups) are.

The ESA was further amended in 1983. Under the Act as it was originally

Despite an abrupt drop in their numbers, monarch butterflies (*Danaus plexippus*) overwintering in California are denied protection by the 1978 amendment to the Endangered Species Act. Photograph by Carly Voight.

written, any destruction of habitat was considered a "taking" and was prohibited. The 1983 amendment allows development on habitat regardless of how critical that habitat might be by permitting the taking of listed taxa if certain conditions are met, including the preparation of a conservation plan for the remaining population.

This amendment is widely considered to be a political compromise between developers and the federal government, reached in order to allow houses to be built on San Bruno Mountain. In the early 1980s, San Bruno Mountain was the largest undeveloped parcel of private land on the San Francisco Peninsula. It was also the site of critical habitat of the mission blue butterfly (*Icaricia icarioides missionensis*). After the amendment was passed, the proposed developments on San Bruno Mountain were delayed only until a Habitat Conservation Plan for the mission blue (and several other listed species) could be completed. Under the terms of the HCP, some land was preserved, while other areas—including parcels that contained habitat of the butterflies—were built upon. The San Bruno Mountain HCP became a national model for allowing land development even in the presence of endangered species, but it remains controversial, along with the overall concept of Habitat Conservation Plans.

Politics have not just led to amendments to the ESA; they have also changed the way it is applied. "Unfortunately," as Xerces president May Berenbaum wryly notes, "listings have been more

influenced by political climate change than by ecological climate change." For example, in 1975, as governor of California, Ronald Reagan expressed doubt that insects need protection, saying, "In spite of our all out-war against certain undesirable insects over countless years we've failed to eliminate a single species." This animosity continued into his presidency; in his second year in the White House, the ESA was revised to exclude any insects that present a risk to agriculture. This provision, though, has never been used, and it is highly unlikely that any species on the brink of extinction would qualify as a pest.

This negative attitude was also reflected in the fact that listings of insects under the ESA ceased during the early years of the Reagan administration. Stanford University biologists then successfully sued the U. S. Fish and Wildlife Service (USFWS), forcing it to list the bay checkerspot butterfly (*Euphydryas editha bayensis*); even so, only six insects were listed over the eight years of the Reagan administration. Under President George H. W. Bush, listing of insects continued at a low level (with seven species listed in four years), as it did during the Clinton administration (seventeen listed in eight years). Then, during the presidency of George W. Bush, not only did listings come to a virtual halt, but the USFWS often failed to follow the law, nor did it accept the recommendations of its own scientists. For example, a multiagency team of scientists proposed the protection of more than thirty-six thousand acres of critical habitat in Nebraska for the recovery of the Salt Creek tiger beetle. At the prompting of the USFWS, this estimate was revised downward to fifteen thousand acres, and eventually the USFWS proposed to protect fewer than two thousand acres—an amount described by one member of the original team as scientifically "ludicrous."

Despite the equality of protection offered by the ESA, invertebrates are significantly underrepresented among listed species. A little more than 10 percent of the endangered or threatened animal species listed by the USFWS are insects—sixty of 582 species—yet they make up more than 72 percent of global

Tiger beetles are often found near rivers or beaches, sites much sought after by developers. The endangered Ohlone tiger beetle (*Cicindela ohlone*) is no exception. Photograph by Joyce Gross.

animal diversity. If we look at it another way, approximately 18 percent of United States' vertebrate species are listed as threatened or endangered; even if we assume merely that invertebrates face destructive forces no greater than those faced by vertebrates and at similar levels of intensity, we would expect to find on the order of sixteen thousand at-risk invertebrates species in the United States, rather than sixty.

Although the ESA's potential for protecting insects is significant, its record of accomplishment on their behalf is relatively modest. This may be due more to societal factors that favor vertebrates, and to the way that the law has been implemented, than it is to the law itself. A chronic shortage of funding, limited knowledge of and scientific attention to many insect groups, and a lack of concerted action by conservation organizations may all be factors that have resulted in lower success relative to vertebrates. Still, the ESA is a valuable and necessary tool in our efforts to conserve biodiversity, offering a safety net for those species at the greatest risk of extinction. Thanks to the Act, some insect species are showing signs of recovery, while others might now be extinct were it not for its continuing role.

The ESA remains the only national law in the United States that specifically protects imperiled insects and their habitats, and—particularly if it is adequately funded—it can be an integral part of the effort to protect the country's immense biological richness. The Act has drawn attention to the crisis of extinction that confronts not only birds and mammals, but also the myriad animal species that, although less conspicuous or less aesthetically pleasing, are no less important. It remains the best insurance program that invertebrates have.

Scott Hoffman Black, the executive director of the Xerces Society, has been involved in the protection of endangered species for two decades.

Once found in thirty-five U.S. states and three Canadian provinces, the American burying beetle (*Nicrophorus americanus*) is now known in only six states. Photograph by Doug Backlund.

Xerces Shares in National Butterfly Conservation Award

We're proud to report that the Xerces Society shared the Wings Across America 2012 Butterfly Conservation Award from the U. S. Forest Service. The award was given to the Interagency Mardon Skipper Work Group, which includes federal and state agency staff from Washington, Oregon, and California.

Although the Xerces Society was not formally a member of the work group, we collaborated closely with it on surveys and research. In recognition of this contribution, Xerces' executive director Scott Hoffman Black was named as a recipient, the only non-agency person to share in the honor.

Protection for the Arapahoe Snowfly

Two years ago, the Xerces Society petitioned the U. S. Fish and Wildlife Service to have the Arapahoe snowfly (*Capnia arapahoe*) protected under the Endangered Species Act. The only known populations of the Arapahoe snowfly are in two small tributaries of the Cache la Poudre River in the Front Range of Northern Colorado; both are on U. S. Forest Service land.

The USFWS recently announced that protection is warranted, but the backlog of higher-priority actions precluded listing. Although this does not mean legal protection for the snowfly, under this ruling all federal agencies must treat it as endangered.

The petition was submitted by the Xerces Society together with several collaborators, including Dr. Boris Kondratieff, an entomology professor at Colorado State University, who has done much of the field survey work for this species.

For more information on the Arapahoe snowfly, please go to www.xerces.org/arapahoe-snowfly.

A New Report on Neonicotinoids and Bees

A possible link between neonicotinoid pesticides and honey bee die-offs has led to controversy across the United States and Europe. Xerces Society scientists undertook a comprehensive review of research and published papers, the result of which was publication in March 2012 of *Are Neonicotinoids Killing Bees?*

Neonicotinoids are systemic and are absorbed into plant tissue. This means that they can be present in pollen and nectar, sometimes at concentrations lethal to bees. Neonicotinoids are also long-lived—lingering for as much as six years in woody plants—and they persist for months or years in the soil, where they can be absorbed by untreated plants the following year.

Products approved for homeowner use in gardens and on lawns and ornamental trees have manufacturer-recommended application rates up to 120

times the rates approved for agricultural crops. Homeowner products have no mention of the risks to bees.

Are Neonicotinoids Killing Bees? recommends that regulators reassess the bee safety of all neonicotinoid pesticide products, reexamine or suspend all conditional registrations until we understand how to manage risks, and require clear labels so that consumers know that these products kill bees and other pollinators.

Download the report at www.xerces.org/neonicotinoids-and-bees/.

Xerces Launches *Bring Back the Pollinators* Campaign

Have you signed the Pollinator Protection Pledge? The pledge is a key part of *Bring Back the Pollinators*, a newly established Xerces conservation campaign. The campaign is based upon four central principles: grow pollinator-friendly flowers, provide nest sites, avoid pesticides, and spread the word. With these core practices, pollinator conservation can be adapted to any location, whether an urban community garden or a farm, a suburban yard or a city park. The new campaign has spread quickly thanks to promotion by the Rapid Refill toner cartridge company, and hundreds of people in North America and Europe have signed the pledge in the past month.

To sign the pledge, please visit www.xerces.org/bringbackthepollinators/. You can also purchase our new pollinator habitat sign to identify any habitat you have created or protected.

The Society is already known for its highly rated pollinator conservation short courses, the excellence of its technical advice to agencies, and such widely acclaimed books as *Attracting Native Pollinators*. We will continue with all of these efforts, but we're excited to launch *Bring Back the Pollinators*, which provides an expanded opportunity for our members (and nonmembers) to be directly involved in pollinator conservation wherever you live or work.

Xerces' new sign can be purchased to designate your garden as pollinator habitat.

Staff at Xerces Grows Apace

The growth of Xerces over the past year has been phenomenal. When our Portland office moved in August 2011, it felt as though we were rattling around in the new space. We're now beginning to fill up!

Michele Blackburn joined the aquatic program, working on a variety of projects including the Migratory Dragonfly Partnership. The endangered species program gained Rich Hatfield to work on bumble bees and Alexa Carlton to focus on butterflies. The pollinator program also expanded, with Nancy Lee Adamson filling a joint position with the USDA-NRCS in North Carolina.

As our conservation staff has grown, so have our administrative needs. Mary Ann Lau is our new accounting assistant, and Erin Green joined us in the last few weeks to help with membership and development.

Winners of the 2012 Joan Mosenthal DeWind Awards

The Xerces Society is pleased to announce the two winners of the 2012 Joan Mosenthal DeWind Awards, given annually to university students who are engaged in research that will further the conservation of butterflies and moths. Each award is worth $3,750.

Rachael Ryan of New Mexico State University will be gathering genetic data from separate populations of the Sacramento Mountains checkerspot (*Euphydryas anicia cloudcrofti*) to better understand how environmental change influences the stability of these two populations. This data will be used to model how butterflies will respond to climate change over the next hundred years.

Jana Slancarova of the University of South Bohemia in the Czech Republic will study the effects of abandonment of formerly grazed lands in Bulgaria, Macedonia, and Greece. Her research will provide a picture of how land abandonment affects Lepidoptera in the South Balkans, and will help to inform conservation decisions in that region.

Congratulations to both Rachael and Jana!

***WINGS*, Spring 2012** **Volume 35, Number 1**

Wings is published twice a year by the Xerces Society, an international, nonprofit organization dedicated to protecting the diversity of life through the conservation of invertebrates and their habitat. A Xerces Society membership costs $30 per year (tax-deductible) and includes a subscription to *Wings*.

 Xerces Society Executive Director: Scott Hoffman Black; *Editors*: Scott Hoffman Black, John Laursen, and Matthew Shepherd; *Design and Production*: John Laursen. Printed on recycled paper.

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

THE XERCES SOCIETY FOR INVERTEBRATE CONSERVATION

628 Northeast Broadway, Suite 200, Portland, OR 97232

toll-free 855-232-6639 fax 503-233-6794 info@xerces.org www.xerces.org

The giant Palouse earthworm (*Driloleirus americanus*) may grow to be more than two feet long. It continues to survive in areas of undisturbed prairie near the border between Washington and Idaho, but surveying for the earthworm is very difficult, making it hard to implement conservation action on its behalf. Photograph by Lee Matthews.

A $30 per year Xerces Society membership includes a subscription to *Wings*.

Our cover photograph is of a Carson wandering skipper (*Pseudocopaeodes eunus obscurus*). The skipper was listed as endangered under the U. S. Endangered Species Act in 2002 thanks to a petition submitted by the Xerces Society. Photograph by Mace Vaughan.