WINGS

ESSAYS ON INVERTEBRATE CONSERVATION

THE XERCES SOCIETY SPRING 2008

Insects and the City

Sacha Spector

I spotted the first one as I emerged from the subway into the bright sunshine of a crisp autumn morning. I watched another, and then two more wing their way down Broadway. As I walked to my office at the American Museum of Natural History, I counted them heading along each avenue. Southward, down Amsterdam and Columbus Avenues and Central Park West, they streamed by the dozens. Monarch butterflies, migrating in the millions to their winter roost in Mexico, were gracefully navigating the canyons of New York City (but ignoring traffic regulations, since Amsterdam Avenue runs north only). It was a wildlife spectacle as exhilarating and inspiring as any I've witnessed.

It was also a breathtaking reminder of the power that invertebrates have to connect the three billion of us who live in urban settings with the natural world. Already, half of the world's human population lives in cities, a global trend that will continue well into this century. For the urban dweller it is the orange and black flash of a monarch rather than a tiger or jaguar, the call of the katydid instead of the howl of coyotes, that provide our most intense moments for remembering that even our biggest metropolises are part of something greater.

During their migration, monarch butterflies can be found in a wide variety of locations ranging from flower-rich prairie to busy city streets. Monarchs are regular visitors to countless gardens; their presence provides a direct link between natural areas and the most densely urbanized regions. *Danaus plexippus*, photographed on marigold by Gretchen Halverson.

Of course, invertebrates in cities are old news—we have always lived side by side with species that appreciate the stable, nourishing niches to be found in our buildings and our pantries. In some sense though, even those sometimes unwelcome species that share our homes with us offer connections to the larger realm of wild, amazing nature. That house centipede hunting under your sofa has a few relatives that hunt for bats on the roofs of tropical caves. Central American cousins of that American cockroach hiding behind your refrigerator form stable, male-female pairbonds and cooperate for years to raise their young. The silverfish that nibble our books belong to one of the most ancient insect orders, Zygentoma, whose direct lineage goes back nearly four hundred million years. In other words, we bunk down with living fossils and voracious predators and nurturing insectine parents.

At the same time, as if to remind us that we have a lot to learn about the possibilities of invertebrate life in the city, undiscovered species keep turning up in urban centers. *Nannarrup hoffmani*, a genus and species of centipede new to science was found in Central Park, virtually across the street from my office, just a few years ago. Last year three new species of pholcid spiders were described from the urban forests of São Paolo. There are many new stories to uncover and tell in the heart of the urban jungle.

The stories in this issue of *Wings* celebrate the variety of urban invertebrates and explore the challenges of conserving them in the midst of our most populated regions. Kevin Matteson demonstrates the value of New York's community gardens and pocket parks as surprising outposts of insect diversity and enriching points of neighborhood connection. Travis Longcore and Catherine Rich describe the intensive efforts that are needed to sustain endangered insects in California's urban habitat fragments. The complexity and ferocity of the arachnid micro-predators that can be found all around us are the subject of Greta Binford's essay on backyard spiders. From the other side of the Atlantic, Matt Shardlow provides evidence and hope that pockets of England's degraded, post-industrial urban areas can be repurposed as refuges for early-successional species. Finally, Celeste Mazzacano, Scott Hoffman Black, and Matthew Shepherd take us on a trip down urban streams that are polluted but promising in their resilience, and are home to many of our nation's most endangered invertebrate species.

Together, the contributors to this issue provide a powerful argument that it is time to re-examine the ways we encounter and conserve invertebrates in urban settings. I invite you to enjoy these essays—and then to get out there, whether by taxi, bus, or simply pounding the pavement, and become an urban invertebrate explorer. You'll be pleasantly surprised. I'll bet my subway pass on it.

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Entomologist in the Big Apple

Kevin Cox Matteson

I pedaled my bike southward in late afternoon traffic on Third Avenue in East Harlem in New York City, carefully avoiding double-parked cars and delivery trucks. The sidewalks were packed with outdoor vendors and shopping pedestrians. At 113th Street, I bounced over a large pothole, jarring my digital camera and nearly knocking my insect net loose from its precarious attachment to my bike. I glanced at my watch. It was nearly four in the afternoon and I had yet to observe butterflies, net bees, and collect the yellow bowl traps that I had set out twenty-four hours earlier in two community gardens. Soon the sun would dip below the urban horizon of ten-story apartment buildings, resulting in a precipitous drop in insect activity. I turned right on 111th Street, nodded to a group of teenagers hanging out on the corner, and hopped off my bike at the wrought-iron gate of a community garden owned and maintained by the nonprofit New York Restoration Project. I opened the gate, wheeled my bike in-

New York City's community gardens provide sanctuary for many human activities, from dominoes to band practice, even a pet cemetery. Recent research shows that places such as Tremont Community Garden in the Bronx also support a surprising variety of insects. Photograph by Kevin Cox Matteson.

side, and took a deep breath. It was time to catch some insects.

This was a typical day during my doctoral research, conducted in community gardens located in the Bronx and East Harlem while at Fordham University in New York City from 2003 to 2007. It has taken some time to realize that the study of ecology—the interrelationship of organisms and their environments—has daily applications no matter where you live. Although urban residents may visit city parks on occasion, most parks are set apart from human residences, requiring transit by bus or subway. And for children growing up in the city, the block on which they live is their entire world. Therefore, despite the attraction of conducting an ecological study in the "urban wilderness" present in large parks and refuges of New York City (for example, Jamaica Bay National Wildlife Refuge in Queens, Central Park in Manhattan, and Prospect Park in Brooklyn), I found myself seeking field sites located in densely populated neighborhoods, on city blocks where people actually live.

One of the most abundant groups of insects found in urban community gardens are long-legged flies. *Condylostylus* sp., photographed by Tom Murray.

Community gardens, of which there are over seven hundred in New York City, easily fit this "on the block" criterion and provide a unique and challenging research experience. Although small—usually less than twelve hundred square yards (a thousand square meters)—they play a large role in the community and are eclectically utilized by neighborhood residents and full of distractions for the researcher of entomology. My research in these urban gardens was conducted amidst festivals and cookouts, with the perpetual temptation to put down the insect net and digital camera to relax, have a drink, play with the kids, and to be a part of the fun that is summertime in New York City. My chosen research sites were in the Bronx and East Harlem, where several gardens served as local watering holes (bring your own brown bag) and as central meeting spots for playing dominoes. In other gardens, small groups of children would gather to peer at a line of ants marching to a food spill, to unearth worms, or (my personal favorite) to "help" me by chasing butterflies or screaming at bees and wasps. Teenagers used one garden for band practice during the night while a group of men used it for barbecues during the day (which was convenient when I forgot lunch). The corner of one quiet community garden was even used by a self-proclaimed "witch" for ceremonies and by neighborhood residents as a pet cemetery. (Where else in the city are you going to bury your dog or turtle?)

Despite the distractions my research continued, and as data was collected ecological patterns emerged. It is often

the case in urban ecology that some species, labeled "urban exploiters" by Robert Blair of the University of Minnesota, do very well and are extremely abundant, while other species are rare or excluded. This pattern was apparent in these gardens, with several insect species and taxa being superabundant, including the introduced cabbage white butterfly (*Pieris rapae*), the native common eastern bumble bee (*Bombus impatiens*), and metallic-green long-legged flies (family Dolichopodidae). In contrast, other insect groups, such as mining bees (family Andrenidae), were nearly completely excluded, perhaps due to the prevalence of concrete and resultant lack of soils suitable for nesting sites.

Another pattern common in urban habitats is the prevalence of exotic species. Working in collaboration with Dr. John Ascher of the American Museum of Natural History and Dr. Gail Langellotto of Oregon State University, I found within these urban gardens of the Bronx and East Harlem ten of the twenty-one exotic bees known to inhabit North America. We also documented the first New York State record of *Hylaeus punctatus*, an exotic yellow-faced bee native to Europe. In just three decades since its introduction to the New World, this bee has spread from urban areas of Chile and Argentina, to California and Washington, D.C., and now New York. Interestingly, the prevalence of exotic species in some urban areas provides serious challenges for taxonomists (which taxonomic key should be used?), ecologists (are exotic species using vacant niches or excluding native species?), and conservationists (are species likely to spread out of cities to more pristine habitats?).

Butterflies, including the red-banded hairstreak (*Calycopis cecrops*), are regular visitors to New York City's community gardens. Photograph by Lewis Scharpf.

A booming population of native species in larger city parks or outside of the city may result in some individuals spilling over into smaller city habitats. In 2004, several individuals of the small, yet vibrantly colored red-banded hairstreak (*Calycopis cecrops*) turned up in community gardens, although I didn't see them in any other year of the study. Also in 2004, a great spangled fritillary (*Speyeria cybele*), a rare species even in larger parks of the city, was spotted in a garden over 750 yards (700 meters) from the nearest park. Although most butterflies reach gardens via dispersal, on occasion some species may reproduce within gardens, as evidenced by an eastern black swallowtail (*Papilio polyxenes*) caterpillar observed feeding on common rue (*Ruta graveolens*) in a garden on 118th Street in Manhattan.

Rainforests, coral reefs, and other such "pristine" habitats are synonymous in the public mind with biodiversity, whereas cities often are considered too

Several butterfly species disperse from larger parks to community gardens but only a few breed in the gardens. Caterpillars of the eastern black swallowtail (*Papilio polyxenes*) were found in a garden on Manhattan's 118th Street. Photograph by Kevin Cox Matteson.

developed and too polluted to support many species. During four years of research, though, I found a total of fifty-four bee species, twenty-four butterfly species, and over seventy additional insect taxa (predominantly families and subfamilies) in the community gardens. Admittedly, many of the species were exotic or extremely abundant, thus not requiring conservation. Even so, in urban landscapes common wildlife species serve an important role in reconciling urban residents with nature, helping to prevent what Robert Michael Pyle has termed the "extinction of experience." Wildlife in urban habitats can alter human perception of the urban environment (there *is* biodiversity in cities) in addition to providing opportunities for interactions with nature.

Throughout my research, I witnessed many occasions where human curiosity and the enjoyment of nature were abundantly apparent. Elderly men and women would often stop to peer through the gate of a garden. Children stopped and stared when a butterfly would fly out of a garden and briefly alight on the sidewalk. One day, as I emerged from a garden in East Harlem with a yellow bowl trap full of insects, a group of teenagers approached and asked what I was doing. As I explained my research and began to show them the myriad of insects collected, two undercover police officers approached, apparently believing that we were huddled around some sort of new drug paraphernalia. I tried to remain calm as I explained the situation and to my surprise, they were interested. The next thing I knew, all of us, cops, teenagers, and researcher, were peering into a bowl filled with tephritid and muscid flies, pemphrenid and chrysidid wasps, lacewings, and scarab beetles, all floating in a soapy liquid. In these and many other experiences, it was clear that humans

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Invertebrate Conservation at the Gates of Hell

Travis Longcore and Catherine Rich

In the foreground, an endangered Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*) sits motionless in the cool March morning air, wings spread and tattered as it rests on the stem of a deerweed plant. Behind it is the red glow of a fifty-foot-high gas flare, capping a mountain of asphalt covered by tanks and pipes—one of several oil refineries in southern Los Angeles County. The species itself is limited to a three-hundred-acre Navy fuel depot with underground tanks, but the view across the street reminds one of the gates of hell. This is the paradox of invertebrate conservation in cities. Noxious or extreme land uses have historically protected rare and endangered species by maintaining open spaces free from development around them. These remnants are now a necessary focal point for urban conservation.

Conservationists sometimes overlook and undervalue urban fragments. This lack of attention may come from a tendency to think on a human scale and to emphasize larger species, usually mammals and birds. Yet research shows that even sites that might be otherwise derelict and degraded support significant invertebrate diversity. A survey of twenty-six brownfield sites in England—not necessarily as contaminated as American brownfields—found sixty-three carabid beetle species, including two that are nationally scarce. Because

Fragments of habitat survive in even the most heavily industrialized areas. Small areas of such relict habitat can support important invertebrate communities. Palos Verdes Peninsula, Los Angeles, photographed by Travis Longcore.

The El Segundo blue (*Euphilotes bernardino allyni*) spends much of its life in intimate association with the flowerheads of seacliff buckwheat (*Eriogonum parvifolium*). Photograph by Larry Orsak.

invertebrates have small body sizes, a great number can persist on small fragments, and because many invertebrates are habitat specialists, small fragments in cities may represent relict habitats.

Taking off from Los Angeles International Airport (LAX), few travelers notice the scrub-covered sand dunes, crisscrossed in part by the streets of a long-abandoned neighborhood. This is a three-hundred-acre remnant of the El Segundo dune system. Fed by sand from the Los Angeles River, it historically stretched eleven miles along the Santa Monica Bay. This remnant, where earplugs are a necessary defense against outgoing jets directly overhead, is home to at least ten rare or endemic invertebrates, including El Segundo crab spider (*Ebo* new sp.), El Segundo goat moth (*Comadia intrusa*), Ford's sand dune moth (*Psammobotys fordi*), El Segundo scythrid moth (*Scythris* new sp. 1), lesser dunes scythrid moth (*Scythris* new sp. 2), El Segundo Jerusalem cricket (*Stenopelmatus* new sp.), Dorothy's El Segundo dune weevil (*Trigonoscuta dorothea dorothea*), Lange's El Segundo dune weevil (*Onychobaris langei*), a weevil with no common name (*Cylindrocopturus* new sp.), and, of course, the El Segundo blue butterfly (*Euphilotes bernardino allyni*). Although restoration of habitat in the early 1990s resulted in a dramatic increase in El Segundo blue numbers, a lack of management at the LAX dunes since 2001 has allowed the habitat to be degraded by invasive plants and the butterfly population there is declining.

Community-based restoration projects are creating new habitat for the El Segundo blue at other urban sites. Two remnant dune fragments tucked between the beach and the street in the cities of Redondo Beach and Torrance have been restored and were colonized in 2007 by El Segundo blue butterflies from a backyard population over a thousand feet away. Previous research had suggested that the species was quite sedentary, but apparently its dispersal powers had been underestimated. Although these restoration projects are aiding the butterfly, our previous research shows that ground-dwelling arthropods do not respond quickly to restoration, so conservation of flightless species will probably rely on human-aided introduction to restored habitats or on the reinitiation of habitat management on the LAX dunes.

To the public, relict urban open spaces often appear to be wastelands to be ignored, developed, or dumped on. In the absence of a charismatic species such as a butterfly, conservation of urban parcels can be a daunting challenge.

A scrubby dune system fifty miles inland from Los Angeles is home to the only federally listed fly in the United States. The endangered Delhi Sands flower-loving fly (*Rhaphiomidas terminatus abdominalis*) persists in a series of fragments ranging from a few acres to a few hundred. Although the habitat is spectacular with showy flowers after winter rains, its arid appearance in the summer, when temperatures regularly exceed one hundred degrees Fahrenheit (thirty-eight degrees Celsius), wins few fans outside naturalists and dedicated conservationists. The fly's larvae burrow in the sand and adults emerge from the ground to mate, visit flowers, and lay eggs for the next generation. After years of contentious discussion over the species, the City of Colton has proposed setting aside the largest habitat in exchange for rights to develop other smaller fragments. This core habitat is located next to the cement plant at Slover Mountain, a mountain that over the last fifty years has been slowly scraped to the ground and transformed into Colton cement.

Farther north, about forty miles inland from San Francisco, Lange's metalmark butterfly (*Apodemia mormo langei*) contends with a different industrial use: a gypsum factory, which routinely blankets portions of the habitat with a fine dust. Lange's metalmark uses naked-stemmed buckwheat as a foodplant and is limited to a dune system along the San Joaquin River. The remaining habitat is split in two by the gypsum plant. Restoration efforts in the early 1990s led to substantial growth in population, but the trend in the last five years has been one of rapid decline from a maximum daily count of 2,342 butterflies in 1999 to 45 in 2006. Reasons for this collapse are not fully identified, but the shifting sands needed by naked-stemmed buckwheat and other native plants have been covered by a rapid expansion of exotic plant species, including a particularly troublesome species of vetch. Emergency habitat restoration is ongoing, as is a captive breeding program.

Back at the Navy fuel depot in San Pedro, the number of Palos Verdes blue butterflies each year has been volatile, ranging from thirty to more than three

The Delhi Sands flower-loving fly (*Rhaphiomidas terminatus abdominalis*) is restricted to a few patches of sandy habitat. Photograph by Guy Bruyea.

hundred, but with no discernible trend. The base commander has supported restoration efforts and newly created habitats have been successfully "seeded" with butterflies in the past. However, the plants that support the species are early succession specialists and some other areas have lost the butterfly as larger scrub plants have elbowed out the pioneers. Long-term persistence will depend on managing specific areas for food plants with some sort of disturbance (fire is out of the question for obvious reasons). Ironically, the normal operation of the fuel depot for forty years probably provided such a disturbance during the years when the butterfly's presence at the site was unknown.

A successful captive breeding program is underway with Palos Verdes blue butterflies from the fuel depot. Releases in much more scenic sites on the Palos Verdes peninsula are planned. These steps toward recovery would never have been possible without the protective umbrella of the millions of gallons of jet fuel in underground tanks across the street from a refinery.

Cities, and especially industrial districts, are often overlooked by conservationists. An "all-or-nothing" view of natural value has led both scientists and conservationists to concentrate instead on wilderness areas. But in an increasingly urban world, we will need to find opportunities for helping species persist in areas closer to our backyards than majestic national parks. Isolated urban habitats are the only hope for Palos Verdes blue butterfly, Lange's metalmark butterfly, Delhi Sands flower-loving fly, and the endemic insects of the El Segundo dunes. Invertebrates have persisted in the forgotten fragments of our cities and, at times, nowhere else. We have learned that viability of these habitats

Lying on the south shore of California's San Joaquin River, the Antioch Dunes were once more than a hundred feet high and topped with scattered coast live oaks. Most of the dunes were mined away during the twentieth century, and what remains is greatly disturbed. Photograph by Edward S. Ross.

for the long term will require management to overcome the consequences of urbanization. Natural disturbance regimes are interrupted and often must be replicated, either by accident or intent, to maintain native habitats. The consequences of pollution, such as the gypsum dust that wafts onto the leaves consumed by Lange's metalmark larvae or heavy metals deposited by departing aircraft on the El Segundo dunes, are not yet fully understood.

Climate change threatens the urban survivors as well. With no space for range shifts in response to altered precipitation or temperature, managers will have to track these conditions and devise strategies to assist in colonization of new habitat areas. For the Palos Verdes blue butterfly, our preliminary analysis shows that annual abundance is positively correlated with rainfall during the early winter of the previous year. In addition, adults are stressed by above-average temperatures during their spring flight period. The species is well adapted to short-term drought; its pupae can exhibit multiple-year diapause, waiting for better weather conditions to emerge. But in the laboratory most pupae die after a couple of years, suggesting that long-term hotter, drier conditions would be catastrophic for the species. Managing against the risk of such changes means reintroducing the species to locations with slightly different topographic conditions within its historic range where microclimate will be cooler and wetter. Similar challenges face other rare species persisting on urban fragments.

To conserve invertebrate diversity, we should embrace and manage urban fragments. This often requires developing ways to coexist with the extreme land uses that have protected these natural areas from the bulldozer. In the long term we must develop constituencies for sites that might never be considered a romantic spot for a picnic. We must prepare to fight to conserve them in a future when the extreme land uses themselves are phased out. Public support can be difficult to develop, but as such habitats become established, volunteer programs can offer an opportunity to fulfill the desire of so many urban residents to be active stewards of their communities. And therein lies preservation of little bits of wild.

Lange's metalmark (*Apodemia mormo langei*) maintains a tenuous hold on survival at the Antioch Dunes. Photograph by Larry Orsak.

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Tiny Predators in Your Backyard

Greta J. Binford

Spiders grab our attention. Found almost everywhere—in basements, backyards, and parks, and even high in skyscrapers—they bring forth in most people a range of response from fear to disgust to intrigue. Whatever your reaction, by the end of this essay I hope you can see some of what I find fascinating in spiders, and that you will be inspired by these little predators who are constant companions in our daily lives.

Spiders are members of the class Arachnida, a diverse group of invertebrates that all have four pairs of legs and two major body regions (though these are fused in some groups and appear to be a single region). Other commonly encountered arachnids are harvestmen (or daddy longlegs), mites, ticks, pseudoscorpions with venom in their tiny claws, and scorpions with venom in their not-so-tiny tails.

There are roughly forty thousand described species of spiders worldwide, and approaching four thousand species in the United States. A single house and garden may support more than eighty species.

The vast majority of arachnids are highly efficient predators. In fact, they perform an important ecological service by eating large amounts of insects. To be able to capture live prey they have evolved a phenomenal array of tools. Many arachnids have the capacity to produce venom or silk. Spiders have been around for at least 350 million years and during that time they have evolved an arsenal of silk types, web structures, and venom chemistries.

Perhaps these predatory tools, the abundance (as many as a million individuals per acre, by some estimates) and the conspicuousness of spiders have influenced our cultural legacy of fear of these small animals. Often the first concern people have in encountering a spider is, is it poisonous? Venom is certainly something to be respected if not admired. While the venom of a single spider can contain up to a thousand different components (some of which affect the nervous system of prey or break down cell structures or tissues), only a subset of these are directly bioactive, causing a physical or chemical reaction in the recipient. On the whole, the chemicals in spider venoms are targeted toward insect prey, with the overwhelming majority of spiders presenting no hazard to humans: either they never bite people or their bites are harmless.

Two spiders in the United States that do have the potential to deliver dangerous bites are the brown recluse and the black widow. Despite widespread fear of these spiders, few people are bitten each year, and only a small proportion of these experience more than mild symptoms. Neither spider is aggressive; they are inclined to bite people (and who can blame them?!) only when trapped.

As its name suggests, the brown recluse (*Loxosceles reclusa*) generally keeps away from people. The recluse is

one of eleven closely related species in the United States that live across the Southern and Midwestern states; the majority of species diversity is in the desert Southwest. They are all small and brown, with a distinctive violin-shaped marking on their backs (they are also called fiddleback spiders). Fully grown, the recluse has a legspan roughly equal in length to the diameter of a U.S. quarter. In natural areas, they live under rocks and logs, but have adapted well to living in and around human habitations. Active nocturnal hunters, they retreat during the day to small cottony webs in cracks and crevices or other secluded spots. People vary in the severity of their reaction to bites, but venom of all species of *Loxosceles* can cause necrotic lesions.

The black widow is one of three species in the genus *Latrodectus* that live in the United States. Together, they have a wider range in our country than brown recluse spiders. Black widows are most abundant throughout the South, but their distributions extend into the Midwest, up the Eastern Seaboard, and in dry areas of the West as far north as Canada. They build exposed tangled webs, leading to their retreats, with silk threads that are relatively tough and twang like a guitar string when plucked. Their bodies are black and shiny, with the classic hourglass marking on their underside. Their venom contains an unusual feature, a vertebrate-active neurotoxin that enables them to catch small reptiles but also causes severe cramping and pain in humans.

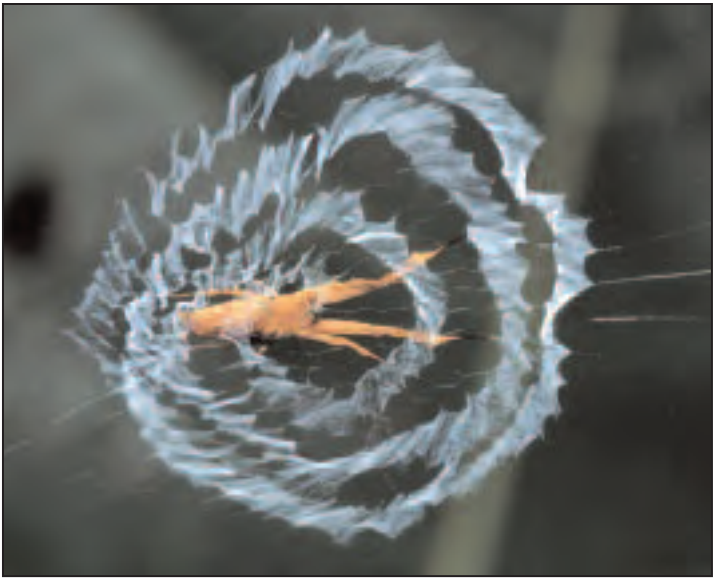
Since their primary life agenda is not biting us or our pets, what are the spiders that we see busy doing? They spend much of their time catching dinner, often using elaborate strategies. Once mature, males are pursuing females, often trying to convince them to mate by using complex dances and displays. If they have already mated, a female may be guarding her eggs or tending her young, some by carrying them around on their backs. They also spend a sig-

Despite its fearsome reputation, the brown recluse (*Loxosceles reclusa*) avoids contact with people. Photographed in Oklahoma by Bryan E. Reynolds.

nificant amount of time doing apparently little, sitting still in webs or under rocks, perhaps grooming themselves by pulling their legs through their jaws.

One of the most abundant and visible signs of spiders are their webs, whether strung over plants, across a doorway, or in the corner of a shed. There are many different types of webs but orb webs made by members of the family Araneidae are the most instantly recognizable. Orb webs make a lot of engineering sense. They are two-dimensional structures that focus vibrational energy toward a central hub. The spiders either sit on or maintain a silk-line connection to the central hub, and are able to detect not only the presence, but also the size and activity levels of anything moving in the web, prey and predator alike. Amazingly, most orb-weaving spiders use different silk for different parts of the web. The silks come from different glands in the silk-spinning organ, called the spinnerets. A single individual orb-weaving spider can make seven different types of silk, each coming from a different spinneret and each serving a different functional role. For example, the radii (or spokes) of an orb web are made from silk that is not very sticky ("ampullate" silk) whereas silk for the spiral has gluey droplets on it to which prey stick ("aggregate" and "flagelliform" silk).

A second group of web builders associated with houses are the Theridiidae, or cobweb spiders. This is a large family that includes the black widows as well as numerous non-toxic species that are among the most common spiders in houses. Their webs are an irreg-



Different spiders construct a wide range of web styles and shapes, from simple spirals to complex tangles of silk. The feather-legged spider (genus *Uloborus*) makes one of the more distinctive webs. Photographed in Trinidad by Bryan E. Reynolds.

Located on the underside of the abdomen, a spider's spinnerets can produce seven different types of silk. *Araneus pima*, an orb-weaving spider, wrapping prey. Photographed in New Mexico by Bryan E. Reynolds.

ular tangle of silk from which lines with gluey droplets at the ends extend down and are attached to a surface below. Hapless prey wandering on the surface bump into them and break the tension of the silk, whereupon the glue sticks to them, pulling them off of the ground as the spider dashes down to bite them and encase them with silk. With this hunting method, larger theridiids such as black widows can capture lizards and snakes! The majority of species catch ants, crickets, and other small arthropods (including other spiders).

Not all spiders ensnare their prey with webs. Two of my favorite backyard spiders, wolf spiders and jumping spiders, both actively wander and use their excellent eyesight to find and stalk prey. Agile and long-legged, wolf spiders (family Lycosidae) use speed to catch prey. Their earth-tone colors and stripes make them hard to spot during the day, but shine a flashlight across your lawn at night and you will almost certainly spot their eyes twinkling like tiny, blue diamonds on the ground. Wolf spiders are very common with different species out hunting during day or night.

Jumping spiders (family Salticidae) provide great entertainment. They are active mostly in the daytime and may be found hunting on vegetation or on the ground. Their acute vision means that they see you as well as prey, and some will turn and face you when you get close. As their name suggests they are excellent jumpers. Stalking prey much like a cat, they stop when they see their quarry, then orient and slowly walk toward it, before pouncing and grabbing it in their front legs and jaws. They do use silk as a safety measure, spinning a strand behind them when they jump. If they miss their target while hunting in bushes and trees, the strand will break their fall.

Great eyesight helps both wolf spiders and jumping spiders to hunt efficiently, but they also use their vision in courtship. Many spiders have elaborate courtship displays, but these two stand

Unlike web-building spiders, the free-ranging wolf spiders (family Lycosidae) do not have a home in which to shelter their young. Females carry their offspring on their backs as they hunt. Photographed in Oklahoma by Bryan E. Reynolds.

out. Males in these groups dance for females by waving their legs and tapping them on the ground, sidling back and forth, and sometimes slamming their bodies on the ground. They may also make sound by rubbing various body parts together. Males have striking markings, tufts, and ornamentation, which in jumping spiders can be very colorful with reds, yellows, purples, blues, greens, and iridescence. (They have been referred to as the "butterflies of the spider world.") Females, of course, watch these courtship displays, with vision so acute that they will respond to video of males replayed on tiny televisions.

Even though they can see you, if you catch them at the right time, spiders will proceed with their courtship rituals right in front of you, offering a small window into the rich world of spider biology in urban areas.

Spiders are inspiring to me because despite their ubiquity, there is so very much we still don't know about them. It isn't hard to discover entirely new things by simply taking the time to sit down and look at them. Most important, a tremendous diversity of species hang out in houses, on porches, and in urban parks. They are accessible and visible. They are our allies, eating the insects that can attack your plants and suck your blood. I highly recommend that people of all ages acquire the habit of taking the time to benefit from the biology lessons, entertainment, and inspiration freely available from the spiders in your own backyard.

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Brownfields as Refuges

Matt Shardlow

Humans like to categorize what they encounter. This tendency extends to zoning land for certain purposes. In Britain, we designate natural areas for wildlife to live in; countryside is where humans and wildlife coexist; and urban land is for people to use. This is fine in principle, but what happens when wildlife does not follow the rules, and "our land" becomes essential for their continued survival?

Since the very earliest civilization we have been dramatically altering the landscape. We mine hundreds, if not thousands, of different substances out of the ground leaving all types of spoil heaps and holes. We build and demolish. We dispose of dredgings, household waste, rubble, and byproducts of industry. And all the while, we create more incidental wildlife habitats. These types of habitat are generally referred to as brownfield sites, a broader definition than that used in the United States, where the term is usually restricted to more contaminated areas.

At the same time, our gentle grip on the countryside has become much firmer. Drainage, deep cultivation, fertilizers, increasing mechanization, and pesticides have stripped much of the wildlife from vast areas. Marginal sites often utilized by rare species include habitats such as bare ground, abundant flowers, scrub and thickets, long grass, and unkempt ponds and ditches. These areas

The shrill carder bee (*Bombus sylvarum*) is one of three rapidly declining British bumble bee species that have important populations on industrial brownfield sites along the shores of the Thames Estuary. Photograph by David Goulson, courtesy of Bumblebee Conservation Trust.

are now much more limited in the countryside. However, these habitats occur on many brownfield sites, which are becoming increasingly important for a range of scarce invertebrates. For example, in Britain the phoenix fly (*Dorycera graminum*) is almost completely restricted to brownfield sites; the distinguished jumping spider (*Sitticus distinguendus*) is known only from two brownfield sites; and the streaked bombardier beetle (*Brachinus sclopeta*) only from one.

There are thousands of brownfield sites that have great value for wildlife in Britain. The most significant brownfields pepper the county's top ten sites for rare invertebrate species, competing with much larger areas of conserved natural and semi-natural habitats. Unfortunately, brownfields are proving to be a perilous sanctuary. Of the three species mentioned, the spider is facing development of both its homes and the beetle has been subject to a relocation project to rescue it from its solitary home, a soon-to-be-developed brownfield site in London.

England is a crowded country and there is enormous demand for land for housing. Between 2006 and 2007, over 160,000 houses were built and there is demand also for land for businesses, particularly for large distribution centres and warehouses. This places big demands on the available space. The current British government is committed to making sure that the development does go somewhere, and, under great pressure not to develop greenbelt or greenfield land—widely perceived as being good for wildlife (although much of it is cropland)—set a key target that 60 percent of all housing development should be on brownfield land. To date, the target is being exceeded: in 2005, 74 percent of new homes were built on brownfields.

Nowhere is this collision between national government policy and biodiversity more strongly felt than on the Thames estuary to the east of London. The Thames estuary is the driest, and one of the warmest, most sheltered parts of Britain and it is home to rare species of spiders, wasps, flies, bees, beetles, dragonflies, and a wealth of other

The streaked bombardier beetle (*Brachinus sclopeta*) is known in Britain from only one brownfield site. Photograph by Benoit Martha.

invertebrates. Known as the Thames Gateway, this area has a long history of development and human disturbance, and the government sees it as a key location for further development.

Along the estuary's low-lying north shore are some of the starkest examples of the destruction of natural habitats. Once, the transition from water to dry land passed through tidal mudflats and thickly vegetated salt marsh, and into an area of rarely inundated upper salt marsh. Known as grazing marsh because it was used by livestock, this area was typified by bare sand and mud interspersed with sweeps of flower-rich, low-nutrient grasslands, and it buzzed with bees, wasps, and other specialized insect life. Now, sea defenses consisting of a large mown bank or wall run across the top of the tidal salt marsh, and the grazing marsh has been replaced by improved farmland, housing, or industrial sites.

But it is not all bad news for the wildlife of the Thames coast. Dozens of rare invertebrate species, including a good number of species that were once associated with flower-rich Thames grazing marshes, somehow survived and have colonized disturbed sites such as a military training camp, a huge chalk quarry, and disused industrial sites. Ironically, some of the sites where humans have had the greatest impact on the visual appearance and surface topography have become some of the most important wildlife refuges. This is well illustrated by two sites in the Thames Gateway region.

Originally a coastal grazing marsh, Canvey Wick was used as a dump for sediments dredged from the Thames and then developed for an oil refinery that was decommissioned in 1973. This has left a ninety-three-hectare (230-acre) area which is quite varied in soil and vegetation structure with wet reedy areas, marshy floods, bramble patches, saline flushes, ditches, ponds, sallow carr, sparsely vegetated gravels, sandy banks, dry grassland, wet grassland, and bare concrete. These habitats have now been colonized by at least thirty invertebrates of the rare and at-risk species listed in the *Red Data Book*, including three that until recently were thought to have become extinct in Britain. Canvey Wick's treasures include the brown-banded carder bee (*Bombus humilis*), the five-banded weevil wasp (*Cerceris quinquefasciata*), the Canvey Island ground beetle (*Scybalicus oblongiusculus*), and the scarce emerald damselfly (*Lestes dryas*).

A fight over the fate of Canvey Wick, set off in 2003 by a proposed business park development, actually led to the protection of most of the site. After action by Buglife—The Invertebrate Conservation Trust, a British nonprofit, the story was picked up in one of the national newspapers (which nicknamed the site "England's rainforest" because of its endangered species), and the developer, a government development agency, retracted the proposal. Two years later, the bulk of the site was designated as a Site of Special Scientific Interest, thereby providing considerable protection from damage or development.

Another highly contentious brownfield is West Thurrock Marshes, a place even more amazing than Canvey Wick. Also once grazing marsh, the site was home to a coal-fueled power station built after World War Two. Subsequently, large areas were covered by pulver-

The four-banded tailed digger wasp (*Cerceris quadricincta*) nests in bare ground and provisions its nest with weevils. It appears to be limited to disturbed areas and waste ground where weevils are abundant. Photograph by P. R. Harvey.

ized fuel ash, a byproduct of burning coal. Despite the disturbance, some wildlife persisted in scraps of marginalized habitat on the site. After the power station closed in the early 1990s, this wildlife began to colonize the fuel ash and the site now contains a mosaic of bare ground, flower-rich grassland, scrub, and salt marsh. It is one of the richest and most important wildlife sites in the country. Species of particular note are the brown-banded carder bee and the red-shanked carder bee (*Bombus ruderarius*), bumble bees that depend on the large areas of flower-rich grassland; the distinguished jumping spider; and the salt marsh shortspur beetle (*Anisodactylus poeciliodes*). It appears that there is only one site in Britain that is home to more rare invertebrate species, Windsor Forest, the centuries-old woodland around Windsor Castle.

The West Thurrock Marshes were designated under established planning regulations for wildlife and open space, but early in 2006 a planning application was submitted to develop a massive Royal Mail distribution center and lorry park. The situation was complicated by the creation of an unelected local development corporation. Reporting directly to the national government, the development corporation is tasked with ensuring that development occurs in the area. The corporation has the power to approve planning applications, and has taken planning decisions out of the hands of local councils and communities. The development will destroy over half of the site, including two-thirds of the critically important flower-rich areas that support key insect species. Many rare animals could be lost from the site forever. A prolonged legal and political fight over the development has ensued. The initial court case supported the decision to grant planning permission, but as this article goes to press the fight is

not finally resolved, and an appeal may be granted. Success for the advocates of the marshes would win the site a reprieve, but it may still be vulnerable to future development. Alternatively, legal action will fail and the damaging development will proceed, highlighting the feebleness of the protection afforded to endangered invertebrates by the British planning system. If we can't protect what may be the nation's second most important site for rare invertebrates, what is safe?

One ray of hope presented by the brownfield dilemma is that these habitats, which are now of such significance to endangered species, were created by humans. If we can continue to create habitats that will support diverse invertebrate communities, and if we can protect and secure beneficial management on the best of the existing sites, then there will be a future for many species that would otherwise have been driven to extinction in Britain. Society is capable of fixing the planning process and achieving this. In 2007, the British government accepted habitat mosaics on previously developed land as a new Priority Habitat. This is a clear recognition of the importance of brownfield habitat and its threatened future, and a strong signal that we need to take more resolute action to ensure that the endangered biodiversity these sites support is given sanctuary.

Matt Shardlow is the director of Buglife—The Invertebrate Conservation Trust. To learn more about brownfield development in Britain, please go to www.buglife.org.uk.

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living in the city are looking for ways to reconnect with nature.

For most entomologists, a perk of their profession is being able to spend long periods of time in nature, away from the noise, traffic, and stress of cities. While urban research is far from quiet, there are numerous perks, which in New York City included a constant availability of fresh-cut mangos in East Harlem, Italian ices in the Bronx, and Mr. Softee ice-cream and Dunkin' Donuts iced coffee throughout. More important, there is much to be discovered regarding the basic biology of many urban insect species, including nesting sites, food resources, and other ecological characteristics. Urban entomologists also can contribute to conservation by providing early identification of potential exotic species invasions, as well as increasing awareness of species that persist in cities. Encounters with urban nature can shape human perception of urban environments; it is humbling for many to realize that amidst the skyscrapers of Manhattan, which are so emblematic of human ambition and self-importance, there are diverse insects quietly going about their business. It is equally comforting that humans aspire to interact with, and continue to be inspired by nature, even in densely populated cities.

Kevin Matteson is a postdoctoral teaching fellow at Fordham University.

Magic in an Urban Stream

Celeste Mazzacano, Scott Hoffman Black, and Matthew Shepherd

Rising on the edge of Colorado's Front Range, Fossil Creek runs eastward, cutting through parts of Fort Collins. In 1995, co-author Scott Hoffman Black was surveying sites along this and another Fort Collins stream, Spring Creek, in an attempt to develop a water-quality monitoring protocol for the city. Fossil Creek seemed to be a good example of a quality urbanized stream. The water flowed over a bed of gravel and river cobbles, with patches of sand and silt in areas where the current slowed. Although the banks were steep due to some channelization, riparian vegetation provided shade as the creek meandered from subdivisions into farmland. Five months of surveys showed a diversity of aquatic life. The presence of mayflies, stoneflies, and caddisflies proved it would be a worthy choice as a reference site to which other creeks in the urban area could be compared.

But in late spring and summer, Fossil Creek was hit by a one-two punch. First, a rainstorm washed tons of soil from a new subdivision into the creek. In places, the gravel was smothered with up to four inches (ten centimeters) of sediment, filling the gaps in which so many aquatic insects make their homes. Then, later in the summer, massive algae blooms occurred, presumably due to fertilizer used on a golf course and lawns upstream. Two insect species collected before these events, a perlid stonefly (*Claassenia sabulosa*) and a net-spinning caddisfly (*Arctopsyche grandis*), were not found again in the months following.

Similar stories have unfolded across America. According to the U.S. Environmental Protection Agency, more than

The invertebrate life in streams can be used as indicator of stream health. As the condition of a creek changes, so does the community of invertebrates that it supports. Mayfly (*Baetis tricaudatus*) photographed in Pennsylvania by David H. Funk.

80,700 miles (130,000 kilometers) of streams and rivers in the United States are degraded by urbanization. The agency has identified soil erosion from new construction as one of the leading causes of water pollution in urban areas.

Less obvious than sedimentation but no less damaging to stream health is pollution. Most people have seen images of huge pipes dumping foaming or discolored water into a stream—or have even seen the pipes firsthand—but much urban pollution does not occur from a single source. Sidewalks, roofs, roads, and parking lots shunt warm rainwater carrying silt, pet wastes, road deicer, motor oil, and other contaminants directly into streams. In residential areas, the quest for manicured, uniform lawns or landscapes can have severe impacts on creeks. A study in the Puget Sound Basin found that more pounds of pesticides were applied per acre in urban neighborhoods than on agricultural fields. Similar studies conducted by the U.S. Geological Survey detected higher concentrations of pesticides in urban streams than those in farmland.

Urbanization also results in channelization or dewatering of formerly free-flowing creeks. When a creek is channelized, invertebrate habitat is lost due to destruction of pools and riffles. The same channelization straightens out the stream meanders, reducing the stream's length. Often streamside riparian vegetation is removed, reducing the supply of coarse organic material and nutrients to the stream. This lack of vegetation also increases the water temperature due to reduction in shading, and it de-stabilizes banks, which causes erosion. The loss of riparian vegetation also destroys areas that many aquatic invertebrates need to pupate and to escape predators as adults. Dewatering, a reduction in the volume of water flowing in a stream, may be caused by water diversion for domestic or industrial use, or by a cut-off of groundwater flowing into the stream. This loss of volume can alter the temperature and chemistry of the remaining water, which in turn affects aquatic organisms.

It is largely due to the invertebrates living in them that streams and rivers are biologically rich. At some stage in their life cycle over 90 percent of all freshwater fish species feed on aquatic insects and other invertebrates. (Their importance in stream food webs means that aquatic invertebrates have a significant economic impact: the U.S. Fish and Wildlife Service reported that freshwater fishing in the United States was a $26.3 billion enterprise in 2006.) The habitat degradation and declining water quality due to urbanization are mirrored by a decline in invertebrate diversity. Among the first to disappear from urban streams are stoneflies, closely followed by mayflies, caddisflies, crayfish, and hellgrammites, leaving in their place a less charming but more pollution-tolerant assortment of midges, worms, and snails.

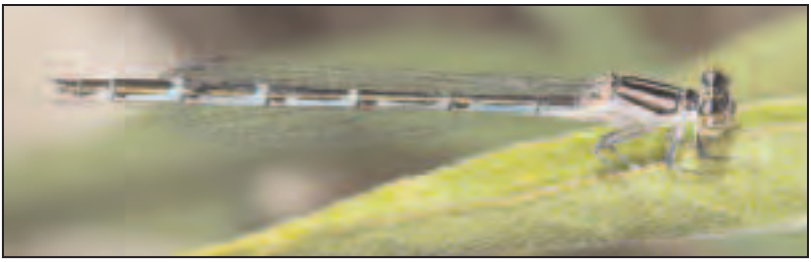
Because aquatic invertebrates are a vital component of stream ecosystems, tracking changes can be an important tool in an effort to understand, conserve, and protect urban waterways. Aquatic invertebrates have been used for water quality monitoring since the early 1900s, and over the last century they have been studied intensively as indicators of the overall biological condition of streams. Today, aquatic invertebrate monitoring is the most wide-

spread measure used to assess the health of the nation's freshwater systems. Some invertebrate species are very sensitive to increased water temperature and decreased oxygen levels; others may be more sensitive to heavy metals or to increased siltation from erosion. Particularly sensitive taxa such as stoneflies can act as early warning systems, with their disappearance serving as a harbinger of declining water quality and habitat degradation.

Yet there is some good news. Even the most profoundly altered urban streams can still contain surprising biological diversity, as well as provide for both fish and other wildlife. A study of urban streams in Fort Collins, Colorado found both high abundance (more than five thousand organisms per square meter) and relatively high diversity (more than twenty-six genera) of aquatic invertebrates at one site. A survey of the Columbia Slough near Portland, Oregon revealed three species of mussels—winged floater (*Anodonta nuttalliana*), Oregon floater (*A. oregonensis*), and California floater (*A. californiensis*)—two of which are rare and at-risk species.

Another reason for optimism is that damaged urban streams can be reclaimed. Citizen interest in watershed protection is growing, with local watershed groups engaging in effective insect monitoring and restoration activities. Some studies have shown that stream restoration is often associated with increased diversity of aquatic invertebrates. One site in Colorado which had been restored with a pool, riffles, and riparian vegetation consistently had the highest diversity of aquatic insects of

Bank disturbance and erosion may be an obvious result of urbanization, but other, less obvious, impacts such as non-point-source pollution and increased water temperatures cause long-lasting changes in invertebrate populations. Photographed in Fort Collins, Colorado, by Scott Hoffman Black.



Populations of damselflies such as this arroyo bluet (*Enallagma praevarum*) may be hit twice by changes to a creek. As aquatic nymphs they rely on cool, clean water and as winged adults they utilize bankside vegetation, which is often lost during urbanization. Photograph by John C. Abbott.

the six sites surveyed in the drainage.

The Xerces Society is intensifying its efforts to protect aquatic invertebrates. We continue to work with regional watershed councils to provide training and educational resources for invertebrate monitoring, including the CD-ROM *Stream Bugs as Biomonitors: A Guide to Pacific Northwest Macroinvertebrate Monitoring and Identification*, which has been purchased by people in every state of the United States and several other countries. We are expanding our work to address aquatic invertebrates in wetland habitats. The recently released CD-ROM *Wetland Invertebrates: An Identification Guide and Educational Resource for Pacific Northwest Freshwater Wetlands* is part of our ongoing effort to provide invertebrate-based tools for assessing wetland quality. We are also preparing a Red List of endangered aquatic invertebrates of the United States to heighten awareness of their plight and help gain protection for the most vulnerable species before recovery becomes impossible.

American naturalist Loren Eisley said, "If there is magic on the planet, it is contained in the water." For some people, the magic is in the clean water they drink, or in the fresh fish they catch, or in the wildlife that riparian areas support. For children, the magic may be in the insects they chase while splashing around in creeks.

Whatever the magic we see as individuals, streams and rivers have always held a central place in human society—as a place to find food, as a source of water for domestic, industrial, and agricultural use, or as an escape for relaxation—and now the majority of the world's population lives near or depends on these fragile areas. Freshwater ecosystems occupy a tiny proportion of the Earth's surface and are greatly influenced by what happens elsewhere. They are, quite literally, downstream of everything that takes place on the land. The story of Fossil Creek is not unusual. The invertebrates that dive, sprawl, graze, burrow, hunt, cling, and float in it (and in thousands of other streams) are the living keystones of any aquatic ecosystem, and we can't afford to lose them.

The authors work for the Xerces Society. Celeste Mazzacano is a conservation associate, Scott Hoffman Black is the executive director, and Matthew Shepherd is a senior conservation associate.

Congressional Briefing on Pollinators and Agricultural Security

In April, the Xerces Society collaborated with staff from Senator Barbara Boxer's office (D-CA) to present a Congressional Briefing on the current status of pollinators. The hour-and-a-half-long briefing included a review of the National Academy of Sciences report on the status of pollinators, as well as updates on colony collapse disorder in honey bees, research into native bees and crop pollination, activities of the Natural Resource Conservation Service, and opportunities for legislative support of pollinator conservation.

Xerces Society executive director Scott Hoffman Black was the moderator and the panelists included (in the order that they spoke) May R. Berenbaum, chair of the National Academy of Sciences Committee on the Status of North American Pollinators and president of the Xerces Society; Jeff Pettis, research leader for the USDA Agricultural Research Service Bee Research Laboratories; Zac Browning, president of the American Beekeeping Federation; Richard Adee, board member, American Honey Producers Association; Doug Holy, national invasive species specialist at the Natural Resources Conservation Service (NRCS); Mace Vaughan, conservation director of the Xerces Society; and Tom Van Arsdall, public affairs representative of the Pollinator Partnership.

Senator Barbara Boxer and Senator Robert Casey (D-PA) provided opening remarks. Senator Boxer, who is pushing for $100 million in federal funding for bee research, noted that many of her state's crops, including almonds and berries, are dependent on healthy pollinators. "There is so much for people to be concerned about here," Boxer said. "Our food supply is under a grave threat."

May Berenbaum initiated the briefing by talking about the importance of pollinators and why we should be doing much more to ensure healthy pollinator populations.

Jeff Pettis, Zac Browning, and Richard Adee agreed that colony losses are greater this year than last, primarily due to colony collapse disorder. They said there is much more that needs to be done to understand and address the problem. In the meantime, beekeepers across the country are finding it ever harder to stay in business.

The NRCS, according to Doug Holy, continues to increase their efforts to help landowners implement pollinator conservation projects on the ground, with new incentive programs and technical training for their staff and partners. The Xerces Society is a major partner in this effort.

Mace Vaughan spoke about the need for additional research into crop pollination by native bees. He detailed what we know about the precipitous decline in some of our native bumble bee species. Concluding the briefing, Tom Van Arsdall observed that it was exciting to see such diverse interests—from conservationists to federal agencies to

growers—coming together over this important issue.

All panelists agreed that there is a need for additional funding to support research into declining bee populations, as well as into the role and habitat needs of native species in crop pollination. The Xerces Society is working with its partners to make sure that this funding is made available through the Farm Bill.

Working to Protect Susan's Purse-Making Caddisfly

Susan's purse-making caddisfly (*Ochrotrichia susanae*) is an endemic species that is restricted to two sites in central Colorado. A micro-caddisfly, it moves slowly across rocks, eating diatoms scraped from the surface. Near the end of its larval stage it uses small pebbles to construct a case, or purse.

This species is primarily threatened by intensive livestock grazing, which results in trampling of spring and riparian habitats, reduction and alteration of riparian vegetation, increases in bank instability. This, in turn, leads to an increase in sediment and turbidity—and to increased nutrient concentration due to livestock waste. Other threats include the effects of timbering projects, dewatering of spring habitats due to increased water demand for livestock and surrounding cities, and habitat damage from off-road recreational vehicle use.

The Xerces Society is working with a coalition of scientists and conservation groups to obtain protection of this rare species. To that end we have developed a comprehensive status review and are working to achieve protection for this caddisfly and its habitat under the United States Endangered Species Act.

Butterfly-a-Thon Update

In the gray of southwest Washington State's new year, Robert Michael Pyle set off in his trusty car, Powdermilk, laden with supplies and equipment. Initially heading west toward the coast, he then navigated south through Oregon and California. Now four months into his Butterfly Big Year, Bob has skirted the United States' border with Mexico and the Gulf Coast to reach the southern tip of the Florida mainland. He meandered across Georgia and adjacent states to follow spring across the southern states. The last sighting of Bob was in Texas.

The weather has not been cooperative, with unseasonally wet and gray conditions in California, Texas, and Florida. However, starting with a California tortoiseshell in his own woodshed on New Year's Day, Bob has seen 140 species of butterfly. He hopes to see hundreds more by the end of this year.

You can follow Bob's progress by visiting his blog on the Xerces web site, www.xerces.org. As unconventional as ever, Bob is not typing his blog but mailing updates written on postcards, note paper, even leaves! All of these can be viewed at www.xerces.org, an entertaining way to track his progress.

Xerces Staff Deliver Message Across the United States

Xerces staff members have fanned out across the country, giving dozens of presentations to a wide range of audiences from university students and master gardeners to agency staff and land managers, and also to a few scientific conferences.

Some of the more significant gatherings addressed were the International Pollinator Symposium held in Iowa, the Michigan Fruit and Vegetable Expo, and the Land Trust Alliance's national meeting in Colorado.

The Society was responsible for organizing an insect conservation symposium at the Entomological Society annual meeting in San Diego, California. Elsewhere in that state, we gave presentations to the California Board on Food and Agriculture, the annual meeting of the California Association of Resource Conservation Districts and the Ecological Farming Conference.

Our partnership with the USDA Natural Resource Conservation Service continued with seminars given in Virginia and California. In Oregon, speaking engagements included Polk County Master Gardeners and the Oregon Zoo's Wildlife Conservation Lecture Series.

Xerces Society Offers New Publication

Our new publication, *Pollinators in Natural Areas: A Primer on Habitat Management*, provides a summary of the ways in which land managers can protect and provide habitat for bees, butterflies and other pollinators.

This eight-page booklet reviews the potential impacts of fire, grazing, mowing, herbicides, and insecticides, and provides a series of recommendations for how land managers can adjust their use of these management actions to benefit pollinators. It is available for download from our web site or can be purchased by contacting our office.

2008 DeWind Award Winners

The Xerces Society is pleased to announce the recipients of the 2008 Joan Mosenthal DeWind Award for Lepidoptera Research and Conservation.

Allison Leidner, of North Carolina State University, is studying the population structure and movements of a newly identified species of skipper (genus *Atrytonopsis*) within heavily fragmented sand dune habitat along a thirty-mile stretch of North Carolina's barrier islands. This work seeks to determine the effects of habitat fragmentation and urbanization on the butterfly, and help to identify conservation strategies for the species.

Climate change is predicted to alter species distributions, potentially disrupting relationships between different species. Genoveva Castañeda, of Tulane University, will experimentally extend the altitudinal range of ants, the dominant predators of *Eios* geometrid caterpillars in the Andean mountains of Ecuador, in order to investigate the impacts of increases in global temperatures on ant-plant mutualisms and distributions of Lepidoptera.

Kurt Illerbrun, of the University of Alberta, also received an award for research related to climate change. Working in the Canadian Rockies, he will examine the effects of an advancing tree line on the distribution and abundance of spearleaf stonecrop (*Sedum lanceolatum*), hostplant of the Apollo butterfly (*Parnassius smintheus*), and relate these effects to the herbivore pattern of Apollo caterpillars.

The Xerces Society congratulates all three recipients on their award and wishes them all success in their studies.

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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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Not all spiders use a web to catch prey. Jumping spiders (family Salticidae) are alert and active hunters that roam vegetation, using their excellent eyesight to locate and track their prey. Photographed in Oklahoma by Bryan E. Reynolds.

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Ourcover photograph shows a web spun by a spider in the family Araneidae. Instantly recognizable, these flat, spiraling webs are the staple of children's books and movies such as *Charlotte's Web*. Photographed in North Dakota by Bryan E. Reynolds.