WINGS

ESSAYS ON INVERTEBRATE CONSERVATION

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Introduction

Scott Hoffman Black

During the 1990s I worked for conservation organizations devoted to protecting big places and big animals: ancient forests, wild rivers, spotted owls, salmon. Because it was focused on saving large, charismatic wildlife, the conservation community within which I worked did not think much about tiny creatures such as insects. But with my background in ecology—specifically, working with invertebrates—I often thought about how our work provided habitat for these little-thought-about animals. When you protect a large landscape, you are, of course, providing for invertebrates. By not logging, building roads, or over-grazing, you are protecting habitat for both big and small, but the latter are seldom part of the plan.

In this issue of *Wings*, we explore the idea of "piggyback" conservation—how the conservation of one species can lead to the protection of others. The first essay lays the groundwork by discussing what this concept means and brings us full circle to an instance of vertebrate conservation piggybacked onto pollinators. We look at the situation of a rare butterfly that literally cannot escape the heat during controlled fire to improve habitat. Two articles explore the ways that the Farm Bill's provisions for providing bird habitat may help or harm insects depending on the circumstances. Last, we delve into the case of horseshoe crabs, for which survival may depend on efforts to protect the red knot, a migratory shorebird.

Conservation programs for animals such as the bobwhite quail can benefit invertebrates—and may in fact rely on them for success—but often overlook them during planning. Photograph by Bryan Eastham, courtesy of iStockphoto.

Piggyback Conservation

Claire Kremen

When I was a young staff member at the Xerces Society in the early 1990s, our constant challenge was to generate interest in conserving invertebrates, their habitats, and the critical functions they provide for maintaining biodiversity and ecosystem health. Nearly two decades later, it is still my instinct to "piggyback" the goals of insect conservation onto other more popular or attention-getting objectives. But is that still necessary? Some recent events have made me wonder whether perhaps—just perhaps—insects and other "orphan taxa" may yet take center stage in conservation efforts of the future.

But first, let's talk about piggybacking, the insect conservationist's foremost tool, in which we use existing projects, legislative efforts, or environmental policies that promote conservation objectives of relatively wide public interest to advance more-esoteric conservation goals. The time-honored "umbrella species" approach embodies this concept. In theory, choosing high-profile, charismatic, and area-demanding species such as grizzly bears, pandas, or golden lion tamarins as "flagships" for conservation has the incidental effect of protecting many other species. In the United States, the Endangered Species Act requires the protection of adequate habitat for a listed species to recover, providing the potential for these species to serve as umbrellas. The problem is that this umbrella concept doesn't always work to protect those members of an ecosystem whose habitat needs aren't being explicitly considered. For example, the excellent work of Hawai'i-based entomologist Dan Rubinoff clearly showed that conservation planning for the California gnatcatcher (*Polioptila californica*), intended as a flagship for California's endangered coastal sage-scrub ecosystem, did not adequately protect several rare moth species, including the electra buckmoth (*Hemileuca electra*), a subspecies of which is found only in this scrub ecosystem. The buckmoth required more land for survival than the gnatcatcher did.

In my work designing protected areas in Madagascar, which first started during my days with the Xerces Society (see the summer 1992 issue of *Wings*), I had several opportunities to piggyback insects onto other conservation work. Madagascar is one of the "hotspots" of global biodiversity. In this fabulous island environment, evolution acting in isolation from the rest of the world has produced a unique and highly diverse flora and fauna; in many groups, more than 90 percent of species are found only in Madagascar. One group of butterflies, the satyrines, is represented on the island by a very large number of closely related species (a phenomenon biologists call adaptive radiation). The genus *Heteropsis* is represented by approximately sixty species on the island, and the genus *Strabena* by fifty species. The satyrines have the misfortune of being small, brown, and quite difficult

Satyrine butterflies have been important in planning new parks on Madagascar. Unlike many species on that island, satyrines may appear drab at first glance; looked at more closely they are really quite beautiful. *Strabena argyrina*, photographed by David Lees.

to identify to species. Although many people do not consider these butterflies attractive enough to be worthy of attention, they are actually very beautiful on close inspection. Not surprisingly, this difficult group was poorly known even by entomologists, and, working with my colleague David Lees of London's Natural History Museum, I found many new species. In addition, we consistently found this group of butterflies to be highly informative for conservation priorities. It's quite unlikely that the public would ever accept building a conservation plan based solely on these dun-colored insects, but we used data on this group, along with data on lemurs, birds, small mammals, and tiger beetles, to design Madagascar's largest park, in the remote rain forest of the Masoala Peninsula. Just recently, Dimby Razafimpahanana, Alison Cameron, Tom Allnutt, and myself, along with many other colleagues, helped the Malagasy government achieve an even more ambitious target, identifying priority areas to triple the size of the protected area network to cover 10 percent of the entire island. Along with the data on plants and vertebrates that are typically employed, we assembled information on ants and butterflies to use in developing the plan. Our study (published in the international journal *Science* in 2008) conclusively demonstrated that it is essential to include multiple indicator groups in order to develop effective conservation plans for biodiversity. Protecting the lemurs would not provide a good outcome for the ants, and vice versa. This finding echoed earlier work by Craig Moritz in the wet forests of Australia, which showed that data on insects provided far greater spatial resolution for conservation planning than did vertebrate data.

California's Central Valley is dominated by agriculture, with habitat restricted to the surrounding hills and riparian areas. As part of the effort to re-wild parts of the landscape in the agricultural areas, hedgerows have been planted for wildlife. Photograph by John Anderson, courtesy of Hedgerow Farms.

Taking another tack in California's Central Valley, an agricultural region that produces a quarter of the United States' fruits and vegetables, I am on a campaign to re-wild the monocultures that now blanket this huge expanse. Through restoration of native plant hedgerows, the goal is to bring back some of the ecological services, such as pollination and pest control, that natural habitat used to provide within agro-ecosystems. Many growers are receptive to the hedgerow concept, but for varying reasons. For some, it's because they like to hunt, and they need to restore some habitat on their fence-row-to-fencerow farmed lands to bring back the quail, pheasants, and rabbits. Others are pursuing compliance with California's water-quality legislation and recognize that vegetated waterways will filter out the fertilizers and pesticides that have become so ubiquitous in today's agriculture.

Relatively few growers, however, are drawn to plant hedgerows simply because hedgerows may increase populations of beneficial insects that suppress pests or pollinate their crops. So we piggyback this concept onto water filtration and management, aesthetic beauty, windbreaks, and hunting. Cur-

rently, in a long-term project in nearby Yolo County, California, my laboratory group at the University of California at Berkeley is painstakingly documenting the economic benefits to growers of planting hedgerows, through reduced need to use insecticides for pest control or to rent honey bee colonies for crop pollination.

Honey bees themselves have recently brought attention to the value of ecosystem services fostered by natural areas. The U.S. apiculture industry has been hard-hit of late by Colony Collapse Disorder, a mysterious ailment in which worker bees disappear and colonies die. The American public has become increasingly aware of the problems faced by honey bees and the effects those problems may have on agriculture and the food supply. At the same time, a growing interest in slow food and locally grown food, urban community gardens and "victory gardens," organic produce, and community-supported agriculture, as well as in diversified farming systems, suggests that people are starting to appreciate and even demand more sustainable forms of agriculture. In addition, greater awareness of climate change is accompanied by a growing realization that monoculture systems (including monocultures of honey bees) may be less resilient than more-diversified production systems. This may be the time for a sea change in how we grow food.

By partnering our research with a pollinator outreach program run by the Xerces Society, our pollinator project in Yolo County has had far greater impact than I ever imagined. For example, after hundreds of pollinator workshops and meetings, the Xerces Society has convinced California's Natural Resource Conservation Service (part of the U.S.

Recent declines in honey bees have underscored the importance of native bees for crop pollination. Leafcutter bee (genus *Megachile*) photographed by Rollin Coville.

Small insects such as this sweat bee (genus *Halictus*) may now be carrying the burden of conserving rare plants and animals. Photograph by Rollin Coville.

Department of Agriculture) to provide 90 percent of the costs of habitat restoration to farmers willing to implement a "pollinator conservation hedgerow"—a strip of pollinator-attractive flowering forbs on both sides of a hedgerow of flowering shrubs—thereby providing a diverse community of pollinators with floral resources throughout their long flight season. This year, twenty-two growers are receiving funds to plant such hedgerows, restoring in a small way some of the functions of the fabulous "bee meadows" that John Muir chronicled in his nineteenth-century writings about the Central Valley.

And, in a stunning reversal of the usual piggybacking, the Yolo Natural Heritage Program has asked us to help integrate pollinator conservation into a multi-species Habitat Conservation Plan for the county that will protect over thirty threatened or endangered vertebrate and invertebrate species. Although none of the pollinators in question are at-risk species and thus cannot legislatively be part of the plan, the Yolo planners specifically want us to assess what economic benefit the Habitat Conservation Plan would provide to growers through the enhancement of pollinator populations and the pollination services they provide on nearby farms. The planners hope that identifying these ancillary benefits of conservation will make the overall plan more acceptable to growers and encourage them to adopt it. Have I lived to see the day when vertebrate conservation rides on the backs of charismatic (and valuable) pollinators?

Claire Kremen, a counselor of the Xerces Society, is an assistant professor at the University of California, Berkeley. She was a member of a National Academy of Sciences panel examining the status of pollinators in North America, and recently received a MacArthur Fellowship for her work in ecology, agriculture, and biodiversity conservation.

Butterflies After Fire: Ashes or Phoenix?

Scott Hoffman Black

Consternation, frustration, dismay—these are some of the emotions that can sweep over a lepidopterist when considering the use of fire to manage grasslands. There are valid reasons to hold these feelings, since lepidopterists can point to numerous examples of butterfly loss from meadows following prescribed fires. The other side of the coin, though, is that controlled burning is used to maintain quality habitat. Land managers believe that fire is essential to many natural areas and that without it the areas would become degraded and lose biological diversity overall.

No matter how you feel about it, controlled burning is an increasingly common management tool, and those on all sides can agree that fire has long played an important role in native ecosystems. Prehistorically, most fires were probably caused by lightning, but once humans obtained the necessary skills to start fires they began using them to shape landscapes. Some Native Americans burned grasslands year after year to keep the forests from encroaching and to maintain favorable habitat for the game and plants they traditionally hunted and harvested.

Controlled fire is an important and widely used tool for managing grasslands and forests. Photograph by Rod Gilbert.

Pioneers across the American landscape used fire to clear forests, but gradually a different view of fire took hold, with fire coming to be seen as something that needed to be suppressed wherever possible. From log cabins built by settlers on the prairie to sprawling mansions that now dot the hills above Los Angeles, the construction of permanent structures throughout the country's landscape changed attitudes to wildfire. The arrival of Smokey Bear in the American consciousness in 1944 settled the debate: forest fires are bad and should not be allowed to burn.

There was only one problem. With fire suppressed, the American landscape began to change. Forests grew thicker and trees encroached on meadows and prairies. In some areas this succession eventually resulted in the degradation and loss of these grasslands. The problem has been compounded by the use of such lands for agriculture, housing, and other developments.

Historically, the vast expanse of North America's prairies offered sufficient areas in various stages of succession to support habitat for a wide variety of wildlife. An area could burn—even for miles—and there was still plenty of habitat left for plants and animals. Fast-forward to today: the remaining grasslands are found in fragments scattered through an otherwise intensively managed landscape. This change is not limited to any one region but has taken place across the country. Only a fraction of tallgrass prairies in the East and Midwest remain, and prairie and savanna in the West has fared no better. Without fire many of these areas are negatively affected by both native and non-native invasive plants, changing them from open, flower-rich prairie to shaded areas. Paralleling the decline in grasslands, the animals that rely on them have been relegated to ever smaller patches. Grasslands and meadows now contain some of the most imperiled plants and animals in North America. Several butterflies listed under the U.S. Endangered Species Act require grasslands for survival, and other rare species such as the Ottoe skipper (*Hesperia ottoe*) and the regal fritillary (*Speyeria idalia*) have been seriously reduced on numerous reserves by controlled burns.

So what can be done? Small areas that support extremely rare species need to be managed or they will no longer provide viable habitat, but the management practices we use could lead to the local extirpation or overall extinction of some of these species. Can prescribed fire and rare prairie butterflies coexist?

The mardon skipper (*Polites mardon*) is one butterfly that has evolved with fire. Found only in Washington, southern Oregon, and northern California, this small, tawny-orange butterfly is dependent upon grasslands dominated by fescue and oatgrass, the skipper's two preferred caterpillar host plants. These grasslands have declined dramatically in the past 150 years due to agricultural and residential development, fire suppression, livestock grazing, and the spread of exotic species. More than 95 percent of native prairies in western Washington, for example, have been dramatically altered or destroyed.

In the last couple of years, the Xerces Society has worked with the U.S. Fish and Wildlife Service and the U.S. Forest Service to survey potential habitat for the mardon skipper on Forest

Protecting the mardon skipper (*Polites mardon*) during grassland burning has been a focus of Xerces Society research in recent years. Photograph by Tom Kogut, courtesy of the U.S. Forest Service.

Service lands in northern California. The state was known to be home to only a few very small populations and these agencies wanted to see if surveys would find more sites. The mardon skipper has a short flight season, so all surveys were squeezed into a brief two-to-three-week period when the adults were expected to be on the wing. In 2007 we surveyed dozens of areas, but found no new populations of skippers. Surveys in the second year seemed to be heading in the same direction until the last day of field work.

After a grueling hike the previous day with no success in finding the skipper, my Xerces colleague Logan Lauvray and myself arrived at our last site on Coon Mountain with relative ease. Stepping out of the 4x4 vehicle into the morning sunshine, we looked across a meadow complex dotted with immense Jeffrey pines. Within a minute of walking into the meadow I saw the distinctive shape, color, and flight pattern of a mardon skipper. We soon realized that we had hit the mother lode! Over the course of the next several hours we counted more than a hundred butterflies. This may not seem like a lot but most mardon population counts log only a dozen or so individuals, so we knew we had found a very special site.

Excited about the discovery, we contacted our agency partners to tell them the good news. It turned out that we had found this population just in time. For more than a year, the Forest Service had been planning a controlled burn at the site, a meadow system on serpentine soils of a quality that is rare in the region. These systems are highly fire-adapted and many of the plants and animals associated with them need fire to keep these habitats open; inspection showed that there was considerable encroachment by woody vegetation that could lead to a hot-burning wildfire.

The charred trunks are now the only clue that this area of Coon Mountain has been burned. Photograph by Scott Hoffman Black.

Without management this meadow would become a tinderbox.

There was ample reason to be concerned about a prescribed fire harming the mardon population. The use of fire as a management tool is based on the supposition that prairie and meadow species are adapted to wildfires and thus can cope with regular burns, but the survival of many invertebrates in such circumstances depends upon the presence of nearby unburned areas to offer refuge to populations that will then recolonize the burned habitat. Many studies on a variety of invertebrates, including butterflies, bees, and snails, have found that burning a small habitat fragment in its entirety risks extirpating some species because of limited or no recolonization from adjacent areas.

Often, though, fire practitioners do not take invertebrates into account when planning controlled burns and there are almost never baseline surveys of the invertebrates at a site. They understand that many plants are adapted to fires and know how they will respond. They also know that most mammal and bird species can move out of harm's way, as long as the controlled burn is not done during nesting season. What they are less aware of is that most insects—particularly the larval stages of habitat specialists—are not as mobile as vertebrates. There is also little consideration of the life history of insects. Many butterflies overwinter as larvae or pupae on site. The island marble (*Euchloe ausonides insulanus*), for instance, an extremely rare butterfly found only on the San Juan Islands of Washington state, overwinters as a pupa attached to

a blade of grass. If island marble habitat were to be burned in the winter, when most prescribed fires take place, pupae within the fire area would likely be killed. Winter fires present a similar threat to the mardon skipper. Work by Loni Beyer of Washington State University at Vancouver has shown that these butterflies likely overwinter as larvae at the base of Idaho fescue. Burning the entire Coon Mountain site, then, would risk killing all of the mardon skipper larvae in the area.

With these considerations in mind we met with biologists and fire staff of the Six Rivers National Forest and the U. S. Fish and Wildlife Service to discuss how to modify the burn to ensure long-term survival of the mardon skipper at this site, and also how we might study the impact of this fire on the skipper.

The agency staffers were very open to working with us. Indeed, because they themselves had identified the site as a possible mardon location, they were delighted that we had found it and wanted to do everything in their power to manage for it. But they did have somewhat competing interests: fire was needed to control shrub encroachment and to remove thatch that had built up and was choking out rare wildflowers. Together, we plotted out which areas to burn and which to leave untouched. We also designed a study to test the response of the butterfly to the burn. In the early winter of 2008, around a third of the area occupied by the mardon was burned.

This past summer, following the winter burn, Logan and I returned to Coon Mountain to set up transects to study the mardon skipper in both the burned and unburned areas. Data from this first year showed us what we expected: the number of skippers in the unburned areas was an order of magnitude greater than in the burned ones. On the other hand, the fescue host plant has responded beautifully to the fire and we did see ovipositing (egg-laying) butterflies in the burned areas. For the time being, the shrubs have been pushed back and the areas that were burned are more open and have more light.

We intend to continue this study over the next several years to more fully document the butterflies' response to fire and to determine whether this management plan will ultimately benefit the mardon skipper by providing better-quality habitat. Grasslands, viewed in the big picture, need to be managed to maintain the open conditions that support the many plant and insect species that live in them, and in the effort to manage these prairies and meadows fire can be either an important tool that benefits these butterflies or a threat to their future survival. Burn size, intensity, and frequency are all important elements when managing for invertebrate species. We hope that fire managers will seek information from those who research butterflies and other invertebrates; doing so will help them to prepare management plans that meet the needs of all of the wildlife that rely on these small remnant ecosystems. In turn we also hope that entomologists will respond to controlled fires with an open mind. If we all work together, biological diversity will benefit.

Scott Black is the executive director of the Xerces Society.

Game Birds, the Farm Bill, and Invertebrates: A Win-Win-Win Situation

Wendell Gilgert

With an abrupt whirring of wings and a raucous call, a ring-necked pheasant breaks cover, followed rapidly by the sharp report of a shotgun. The bird jinks in midair and continues its flight over the frosted crop stubble, disappearing into tall vegetation on the far side of the field. For many if not most hunters, hunting is more about the full experience than just the shooting itself. To many conservationists, this type of scene—an introduced bird being pursued across an intensively managed landscape—is disheartening. Yet hunting and similar rural pursuits have provided the underpinning for wildlife conservation on America's working lands for decades. Game birds and invertebrate conservation go hand-in-hand.

For those who spend time afield, the connection between healthy populations of game birds and insects has long been recognized. Our most popular game birds—ring-necked pheasant, turkey, quail, chukar, and grouse—are precocial, that is, they hatch covered in down and with eyes open, and within a few hours the chicks can walk, run, and feed themselves. These game birds belong to the order Galliformes, and are generally referred to as "gallinaceous" (chicken-like) birds. For the first three to six weeks of life, the diet of most

Their role as food sources for game birds has meant that invertebrates benefit from many habitat-creation projects on farmlands. Ring-necked pheasant, photographed by Lukas Maton, courtesy of iStockphoto.

gallinaceous birds is almost exclusively insectivorous; the exception is the woodland grouse, which is primarily vegetarian. From early spring to the middle of summer, most adult gallinaceous birds also rely heavily on insects, spiders, and other invertebrates. With the shorter days, cooler temperatures, and decreased insect availability of fall, the diet of both young and adult gallinaceous birds shifts away from animal matter to seeds, berries, flowers, buds, leaves, and, in some cases, woody stems.

In fact, invertebrates make up an important food source for almost all game birds in North America. At one end of the spectrum are snipe and American woodcock, which feed exclusively on invertebrates as juveniles and adults; at the other end are pigeons and doves, which feed exclusively on plant matter. In between are the many ducks and geese that eat insects or other invertebrates as a significant component of their diets.

According to data from the North American Breeding Bird Survey compiled by the U.S. Geological Survey, populations of some once-common gallinaceous game birds in America—northern bobwhite quail, lesser and greater prairie chickens, greater sage grouse, sharp-tailed grouse, and ruffed grouse—have been in decline for more than four decades. These changes have been attributed to habitat loss due to agriculture; urban, suburban, and energy development; the fragmentation of remaining habitat; the widespread use of pesticides; and invasive species.

In 1985, recognizing the importance of game birds and their shrinking populations, federally funded conservation programs implemented under the Farm Bill embraced measures to sustain wildlife on privately owned, working farm and ranch lands. Such lands cover nearly 70 percent of the surface of the continental United States, so any effort that focuses on these areas has a huge potential to help wildlife. In fact, the Farm Bill has been largely responsible for stemming population declines in upland game birds, as well as waterfowl. Some birds—ducks, geese, and ring-necked pheasants in particular—have experienced population increases.

Grasshoppers are a key component of the diet of game birds such as prairie chicken and grouse. Club-horned grasshopper (*Aeropedellus clavatus*), photographed by Dan Johnson.

Historically, the biennial Farm Bill has been concerned with issues of water, air, and soil improvement, as well as the fiscal security of farmers. It now covers a

The U.S. Farm Bill provides funding to support environmental improvements and habitat creation. Photograph of a buffer strip in Iowa by Lynn Betts, courtesy of the Natural Resources Conservation Service.

much wider range of agriculture-related issues, from school meal nutrition and farmers' markets to crop insurance and biofuels. The bill also provides funding for a slew of wildlife and conservation programs that support the creation of habitat on farms and ranches. Some initiatives supported by the Farm Bill—such as the Conservation Reserve Program, the Environmental Quality Incentive Program, and the Wildlife Habitat Incentive Program—specifically identify fish and wildlife species of conservation concern as a priority. Others target particular habitats: the Wetland Reserve, Grasslands Reserve, and Healthy Forest Reserve programs facilitate the purchase of easements and promote native habitat restoration and management. Most recently, the Conservation Stewardship Program was established to assist landowners in enhancing current conservation activities and adopting additional ones.

More than a billion dollars per year have been appropriated by Congress and made available for conservation through the Farm Bill. The federal agency responsible for delivering Farm Bill programs is the Natural Resources Conservation Service, an agency within the U.S. Department of Agriculture. Working from field offices in nearly every county in the nation, NRCS biologists partner with farmers and ranchers to plan and apply natural resources conservation, restoration, and management. The cost of projects is generally

shared between the landowner and the USDA, but often, in the case of fish and wildlife projects, state wildlife agencies and nonprofit organizations such as the Xerces Society, Pheasants Forever, Ducks Unlimited, or the National Wild Turkey Federation contribute specialist knowledge or additional financing to plan and execute a project.

If, for example, a farmer in Iowa wants to improve habitat for northern bobwhite quail, an NRCS biologist will assess the land for appropriate habitat and work with the farmer to prepare a plan of action. The NRCS biologist will also ensure that the proposal is in compliance with all national, state, and local laws and regulations. In the case of bobwhite quail, the desired habitat is open grassland of the kind referred to as "early successional" habitat, land in the process of change, typically to shrubs and then to forest. Farm Bill programs will provide cash support to the farmer to undertake the necessary work to create such grassland, incorporating a plant community of the right density, structure, and species diversity. Early successional habitat is often managed to produce an abundance of flowering forbs and legumes, which support an array of insects, spiders, and other invertebrates, all food sources for northern bobwhite quail. A farmer can either create grassy habitat on marginal cropland or convert areas of shrubs or woods back to early successional land by use of a variety of techniques, including prescribed burning, brush management, livestock herbivory, mowing, or the judicious use of herbicides.

Of course, the farmer's work doesn't stop there. Because early successional habitat is, by definition, in the process of change, once it has been established the farmer must employ continuous management in order to maintain its status. And because the duration of a Farm Bill program contract is two to ten years (essentially the time it takes to create the habitat), the ongoing cost of maintaining the habitat becomes the

The open, sunny habitats that are created through projects supported by the Farm Bill suit a wide range of invertebrates. Predators like this wolf spider (family Lycosidae) in turn help to control pests in adjacent crop areas. Photograph by Bryan E. Reynolds.

responsibility of the farmer. There is no such thing as a walk-away conservation practice, so we can't be surprised that the farmer needs a good justification for the expense and effort. While insect conservation may be all the justification many *Wings* readers need, the harsh economic climate faced by today's farmers necessitates that they take a more hard-nosed approach. Game birds, and the hunting of game birds, are either a part of their business or a personal passion.

Since 2004, NRCS conservationists have reported more than half a million acres of early successional habitat established or restored on working lands through Farm Bill programs, a boon to both game birds and invertebrates. Over the past five years, Farm Bill programs across the nation have been applied on more than fourteen million acres of farm and ranch lands annually, totaling nearly sixty million acres of habitat improvements. With an even larger overall appropriation for the 2008 Farm Bill, we can expect increasing investment in fish and wildlife conservation over the next five years. In addition, the 2008 Farm Bill specifically articulates increased emphasis on the conservation and restoration of both native and managed pollinators, so the benefit to insects from game bird management will grow. That bodes well for the future of our wildlife resources on America's working lands, and invertebrates—as well as hunters—will benefit.

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Habitats provided for sharp-tailed grouse and other game birds could offer even greater benefit for invertebrates with some minor changes in design or management. Photograph by Lawrence Sawyer, courtesy of iStockphoto.

Missed Opportunities on the Grassy Knoll: Saving the Northeast's Grassland Invertebrates

Sacha Spector

Two. That's the total number of times Rick Cech and Guy Tudor spotted the small, strikingly beautiful, and metallurgically named bronze copper butterfly (*Lycaena hyllus*) during ten years of surveys for their book *Butterflies of the East Coast: An Observer's Guide*. Five years of more geographically focused work by the staff of the Massachusetts Butterfly Atlas Project found just nine specimens statewide. Further south, Connecticut's atlas project turned up a whopping six specimens during a similar time frame, leading to the designation of the species as a special concern in the state. New Jersey, Massachusetts, West Virginia, Virginia, and Delaware also list the bronze copper as imperiled or critically imperiled.

Yet the bronze copper is known to occur in open, wet habitats (such as marshes and wet meadows) from Montana to New Brunswick and south to Virginia and Arkansas. It is generally reported as a common species across the northern and central parts of its range. The species is ranked as "globally secure" by NatureServe, the organization that compiles and analyzes date from all the state and provincial Natural Heritage Programs in the United States and Canada.

Conrad Vispo and his colleagues at the Hawthorne Valley Farm's Farmscape Ecology Program, based in Hillsdale, New York, found themselves documenting bronze coppers with startling regularity. In short order, they had recorded half a dozen new bronze copper locations, with dozens of individuals, in just one New York county. More important, they had a formula for finding more: to find bronze coppers, find farm ponds. All of the sites where the bronze copper was persisting in the Hudson Valley were around small farm ponds in actively managed or recently abandoned pastures and hayfields.

For those in the know about butterflies, the reappearance of the bronze copper in New York was a welcome but not entirely surprising development. And it hasn't been an isolated event for Conrad and his crew, who, as they work to inventory the active and abandoned hayfields, pastures, and farmlands of the Hudson Valley, continue to turn up dozens of native butterfly, dragonfly, and beetle species whose grassland and early successional habitats are increasingly things of the past in the northeastern United States.

At one time, grasslands—that is, pastures and hayfields—were pretty easy to find in the Northeast, even if you were a butterfly like the bronze copper, with minimal flying skills. Beginning in the late 1700s, conversion of the vast eastern forests—once nearly continuous from the Atlantic to the Great Lakes—to farmland had been almost unimaginably swift. By roughly 1850,

The story of the disappearance and rediscovery of the bronze copper (*Lycaena hyllus*) underscores the fact that the needs of the smallest animals often go unnoticed by many farmland conservation programs. Photograph by Bryan E. Reynolds.

more than 80 percent of the forests had been cleared. The modest natural grasslands owing to beaver-created bottomland meadows, hillside fens, or hilltop and sandplain wildfires were now augmented by extensive if anthropogenic clearings. Grasslands, formerly quite limited, became the dominant element of the landscape. From one horizon to the other, a patchwork of pastures and hayfields, punctuated here and there by woodlots and wetlands, provided exponentially more grassland habitat than had existed before. A veritable all-you-can eat buffet for the species whose preferences ran more to grass blades than tree leaves had turned on its "welcome" sign.

In any ecological story of change there are winners and losers, and in this open new world of the Northeast the winners were probably grassland specialists. Indeed, it is suspected that many grassland-loving species colonized the Northeast from the Midwest during this period, exploiting the sudden explosion of grassland resources that had started to look a lot like the Great Plains. But among the winners were also many locals, who were likely specialized for living in naturally open habitats. These were species that had been there all along in the open habitats (which may not have looked too different from the newly created pastures and hayfields), and whose distributions in the Northeast were probably much patchier before the land was cleared. The bronze copper may have been just such a winner, with its preference for wetland edges near open areas suddenly catered to by the farmers who cleared

their forests to the edges of waterholes or created wet meadows where there had been poorly drained bottomland forests. The new human-dominated habitats may have become suitable analogs of those previously widespread but less extensive naturally occurring ones.

Sadly, pendulums swing and real estate bubbles go pop and by the early 1900s the Northeast's great agricultural juggernaut was on the decline. Rich soils, fossil fuels, improved transportation routes, and agricultural innovations made the Midwest the breadbasket of the nation. Northeastern farms were sold or abandoned at a tremendous pace, and trees began to regrow on the landscape that had supported so many grassland species. By mid-century, forest regrowth was a widespread phenomenon and, by the end of the century, the process had run almost to completion. In New York, for example, pastures and hayfields decreased by about 33 percent in area between 1965 and 2006. Today, large swaths of New England and the Mid-Atlantic states are once again blanketed by forests, as they were by agricultural grassland 125 years ago.

This cycle furnished a rousing lesson of nature's resiliency, especially for fans of forests, who might hope that someday other deforested regions will return to their glorious, leafy past. But this change of fortune did not favor the bronze copper, nor dozens if not hundreds of other open-country species whose prospects were fast receding. For them—for the regal fritillary (*Speyeria Idalia*) and the Arogos skipper (*Atrytone arogos*), to pick just a pair out of the many—the salad days were over.

Of course, invertebrates are not the only species whose distributions began to shrink with the decline of the grasslands and shrublands. Perhaps one-third of the Northeast's mammals prefer those open habitats. A handful, most notably the New England cottontails (now found on barely 20 percent of their former range) and the bobcats that prey on them, were disadvantaged by dwindling open lands.

More than any other vertebrate group, though, grassland birds really began to sing the blues in New England. On a continental basis, no other segment of the avifauna has experienced such sharp declines over the past fifty years. According to Breeding Bird Survey data, the New England upland sandpiper and eastern meadowlark populations declined by 84 and 97 percent, respectively, between 1966 and 1991. Annual decline rates of virtually all grassland birds have been frightful: over roughly the same time period in New York, the average size of populations of grassland bird species was reduced by 6.5 percent *each year*. Species such as the grasshopper sparrow, eastern meadowlark, bobolink, woodcock, Henslow's sparrow, northern shrike, and short-eared owl have practically vanished.

Numbers like these make federal and state agencies sit up and take notice. As Wendell Gilgert describes elsewhere in this issue, the attention focused on grassland restoration and management began to increase in the 1990s, taking the form of a veritable alphabet soup of conservation initiatives led by the U.S. Department of Agriculture and U.S. Fish and Wildlife Service. Today, at the federal level, grassland conservation efforts are implemented on private lands through a variety of programs including the Grasslands Reserve, Conservation

Stewardship, and Wildlife Habitat Incentive programs. The new emphasis on grasslands was evidenced in the 2002 Farm Bill and has been expanded since then (with some much-needed leadership by the Xerces Society on pollinator-conservation issues). Bureau of the Interior management efforts on federal lands in national wildlife refuges, parks, and monuments also expanded significantly. State wildlife agencies soon followed the lead of the federal agencies and by the middle of this decade nearly fifty thousand acres of state land in New England and the Mid-Atlantic region were being managed to maintain habitats in early successional stages to help both game birds and song birds. Many of those state agencies began to offer guidance and incentives for grassland conservation efforts by private landowners as well.

The centerpiece of these programs has been restoring regular disturbance to habitats, in effect repeatedly setting the clock back on the successional process to maintain grassy or shrubby open habitats. Mowing, burning, and grazing are the primary tools for accomplishing this goal, and a tremendous amount of academic literature and an array of best management practices have followed. Conservation organizations have stepped forward with useful, easily implemented guidelines for improving grassland habitat that include criteria for determining the best management practice for any given parcel based on its size, condition, and landscape context. And, as Wendell Gilgert rightly concludes, all this attention and funding have been and will continue to be a tremendous boon for grassland biodiversity of all descriptions.

What was surprising about the "rediscovery" of the bronze copper wasn't its local abundance in the Hudson Valley—rather, it was that, in a region where the decline of grasslands and their species was a conservation issue of increasing importance, and where state, federal, and private funds were pouring in for the preservation of grasslands, it hadn't been found sooner. Here was one of the Northeast's rarest butterflies, hiding in plain sight, with nobody watching it but the occasional passing cow. Where were the federal and state wildlife managers, the conservation NGOs, the lepidopterists? Where were the dedicated landowners who really believe in being good stewards of their grasslands?

The lesson of the bronze copper has to do with missed opportunities in our conservation targets and the narrow taxonomic breadth they represent. The vast majority of the state, federal, and private initiatives in recent years establish the recovery of grassland bird species as their near-exclusive focus for site selection and management regimes. Grassland managers are encouraged to mow or burn areas when the breeding season for birds has concluded, usually defined by a convenient date, such as July 15 or August 15, after the fledgling bobolinks and meadowlarks are on the wing. And, come mid-July or mid-August, mow and burn they do, often oblivious to the life cycles of the dozens of other grassland-dependent species beneath their blades or in front of their fires, which are in the midst of feeding, pupating, or egg-laying.

Do we know enough to manage grassland for invertebrates concurrently with birds? The answer is clearly yes.

An awareness of the rich diversity of insects that live in grasslands is the first step toward improved management of these important habitats, and a greater return on the money invested in their restoration. Arogos skipper (*Atrytone arogos*) photographed by Bryan E. Reynolds.

Rigorous research on grassland invertebrate conservation in the United States and Europe has repeatedly shown that managed disturbance can be optimized to conserve multiple sensitive species. Careful rotation of burning, grazing, or mowing on fractions of sites can be coordinated to benefit a variety of life histories and host-plant associations. But designing such management requires an equally careful inventory of the invertebrate habitat at a site—a seemingly obvious step that gets left out of most of the "best practices" documents for bird conservation.

As good as they are, our grassland recovery efforts fail to recognize how many more needy creatures we overlook in the tall grass. We could readily include many of these in our conservation plans, if we were only more aware. As Ann Swengel wrote for the North American Butterfly Association in 1998, "whether butterflies are a management objective or not, butterflies present in the habitat being managed are just as affected by whatever management occurs." The same could reasonably be said for species of every other invertebrate group. Swengel continued, "usually butterflies aren't at the top of a wildlife or habitat manager's agenda, or even on the agenda at all, at least voluntarily." It's time, given the millions we're investing in restoring grassland habitats, and the hundreds of species at stake, that invertebrates finally have their day in the sun on the grassy knoll.

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Can a Bird Save a Living Fossil?

Piotr Naskrecki

Standing on the beach of Delaware Bay as swarms of horse flies did their best to drain me of every drop of blood, I waited for an amazing spectacle to begin. The sun grew dim, and the high tide was nearing its peak. Every year in May and June, during a few nights that coincide with the full and new phases of the moon, the Atlantic horseshoe crabs (*Limulus polyphemus*)—members of the order Xiphosura and not true crabs but more closely related to spiders and scorpions—leave the sandy beds of the ocean, and enter our world, as dry and foreign to them as their wet and dark domain would be to us. Risking their lives, these beautiful and majestic animals enter a strange and unfamiliar terrain, where the lack of water suddenly makes the gravitational force feel stronger. Horseshoe crabs are surprisingly graceful in water, capable of sprinting on the sandy bottom and occasionally enjoying a short swim on their backs. But here on the beaches of Delaware Bay, they plod slowly. Females, who are larger and heavier than the males, are particularly disadvantaged. They can reach weights of nearly six pounds, and by the time they get to the shore, every female has at least one suitor clinging to her back. In some cases she has to drag along not one but two or three males trying to gain access to the eggs she is about to lay.

In the dimming light, I could see spiky tails of countless more crabs as they tumbled in the waves, trying to get to the dry land. By the time the sun had fully set, the beach was covered with hundreds of glistening animals. Females were digging into the sand, making holes to deposit their eggs (nearly four thousand in a single night), while the males fought for the privilege of fathering the embryos. Fertilization in horseshoe crabs is external, and often multiple males share the fatherhood of the eggs in a clutch. Equipped with a pair of big, compound eyes (plus eight smaller ones) and capable of seeing the ultraviolet range of the light spectrum, even in the melee of waves, sand, and the vast array of other males, male horseshoe crabs are very good at locating females. Scientists studying this behavior first suspected that males might be attracted by female pheromones, but as it turns out they rely solely on their excellent vision.

The next morning I found the beach covered with the eggs of horseshoe crabs. Well-rested and ready to start a bright new day, the flesh-piercing flies attacked me with a renewed enthusiasm. Flailing my arms and swatting dozens of flies at a time, I went about flipping crabs stuck on their backs in the sand, and started to look for particularly big clutches of eggs. Freshly laid eggs look like small, milky-colored marbles, no larger then half a grain of rice. After lying in the sand for two weeks, a fully developed egg resembles a tiny glass aquarium, with a petite horseshoe crab twirling inside, impatient to break

the walls of its miniature prison. Once free, the larva catches a wave back into the ocean and will spend about a week floating freely, before settling on the bottom of the shallow shore waters to begin a life akin to that of its parents.

About a hundred years earlier, I probably would have not been able to walk on the beach without stepping on horseshoe crabs. They were so numerous during their breeding season that humans simply had to find some way of using this bountiful resource, and they soon came up with one. Between 1880 and 1920 well over a million horseshoe crabs were harvested each year—killed, ground up, and used as fertilizer and hog fodder. The practice continued until 1970, when the last processing plant closed, mostly because of the complaints about its smell, and also because the harvest dropped to a mere hundred thousand crabs per year. But in its place another industry sprang up, this time killing horseshoe crabs for use as bait for eel, conch, and whelk. Harvesting crabs for biomedical research, especially for their blood, which is used to detect bacterial contamination in medical devices (and marketed as Limulus Amoebocyte Lysate, or LAL) further impacted the population. All of this exploitation has lead to a dramatic decline in the numbers of horseshoe crabs along the East Coast of the United States.

But there were other species affected by the waning numbers of horseshoe crabs. Chock-full of fat and protein, the eggs of the Atlantic horseshoe crab are an ideal fuel for scores of shorebirds. As reliable as a Swiss clock, horseshoe crabs could be counted on to spread a delicious smorgasbord of fresh eggs on the shores of Delaware Bay, always there on the morning following the new and full moon of the late spring months. One bird in particular, the red knot (*Calidris canutus rufa*), owes its very survival to horseshoe crabs. Mixed in with flocks of other shorebirds, the red knot may not

Red knots migrate from the southern tip of South America to their breeding grounds in the Arctic. Success in this journey relies on the presence of horseshoe crabs during their stopover at Delaware Bay. Photograph by William Sherman, courtesy of iStockphoto.

stand out while on the ground, but in flight it exposes its richly colored breast. One thing that does make it stand out from the crowd is its migration, a nine-thousand-mile journey from Tierra del Fuego to the Arctic Circle. This route includes a stopover at Delaware Bay, a desperately needed respite from an exhausting journey. By the time the birds reach the bay, they've lost about half of their body weight. The two weeks they spend feeding here are crucial for them to continue to their breeding grounds. Ever since humans started paying attention to such things, Delaware Bay has amazed people with clouds of red knots descending on its shores every spring. But a few years ago, as the crab population continued to dwindle to a fraction of its former glory, the birds started to disappear as well. Apparently, low supplies of horseshoe crab eggs prevent the birds from putting on enough weight to get to the Arctic and breed. Since 2000 the number of birds overwintering in South America has dropped from fifty-three thousand to fewer than fifteen thousand.

In response to these declines, the ornithological community in the United States sprang into action. Petitions were signed, studies were conducted, and eventually laws protecting the birds were enacted. People had finally made the connection that, if the crabs disappear, so would the birds, and thus we probably should try to save these seemingly lowly invertebrates. In New Jersey, where just a couple of years ago it was acceptable to drive a pickup truck

Mobs of mating horseshoe crabs (*Limulus polyphemus*) throng Delaware Bay at the tide's edge. But these numbers are tiny compared to the hordes that are known to have covered the beach a century ago. Photograph by Piotr Naskrecki.

Masses of horseshoe crab eggs carpet the sand for a week or two, providing a protein-rich food source for migrating red knots. Photograph by Piotr Naskrecki.

to the beach and load it with hundreds of crabs for bait and other uses, it is now illegal to collect a single individual. A U. S. Fish and Wildlife ranger threatened me with a $10,000 fine for picking up a horseshoe crab on a beach in New Jersey, though my intention was to release it immediately after taking a few photographs. He gave me a stern warning but graciously let me go. A similar ban on horseshoe harvesting had been enacted in Delaware but was later overturned. A more lasting conservation measure was the creation in the Delaware Bay of the Carl N. Schuster, Jr., Horseshoe Crab Reserve (named after one of the world's foremost horseshoe crab researchers), an area encompassing about fifteen hundred square miles, where horseshoe crabs are permanently protected from harvesting. Additional help came from the nonprofit Ecological Research and Development Group, which designed a simple mesh bag that allows conch and whelk fishermen to reuse horseshoe crab bait. The use of the bag is now required by law in Virginia, and already the harvest of horseshoe crabs has been reduced by half.

There are signs that these actions are very effective. The population of horseshoe crabs in Delaware Bay has stopped declining, as evidenced by the numbers collected each year in horseshoe crab surveys conducted by enthusiastic volunteers on the beaches of New Jersey and Delaware. It is an open question whether this is enough to reverse the decline of red knots.

It amazes me that it took a bird for people to really start paying attention to the horseshoe crabs' decline. In what I can only describe as a phylogenocide—extermination of an entire lineage—horseshoe crabs have been systematically exploited for more than a century. This may sound overly harsh, but just think about it—the loss of red knots, as unforgivable as it would be, means the loss of only one-ten-thousandth of the genetic pool for birds (or even less, as the visitors to Delaware Bay are merely a

subspecies of *Calidris canutus*, a globally widespread bird.) The loss of one species of horseshoe crabs would spell the loss of a quarter of all genetic heritage of the order Xiphosura, one of the oldest living lineages on the planet. And yet we care more about a migratory bird that contributes little to our wellbeing than we do about a strange, alien-looking beast that has already saved millions of human lives thanks to its use in detecting bacterial contamination of surgical instruments and medicines. How shallow we are.

The extinction of horseshoe crabs is almost complete in Japan, where a local species (*Tachypleus tridentatus*) used to be almost as numerous as its Atlantic cousin. I went there in the summer of 2008 to see the last place in Japan where *T. tridentatus* is still supposed to appear in large numbers. I arrived at Imari Beach on the island of Kyushu on the day before the Kabutogani festival, an annual celebration of horseshoe crabs. I was told that it was a good year—four pairs (!) of horseshoe crabs having been spotted near the beach. Four pairs. Eight individuals. That was it. In the 1980s, seeing five hundred individuals at the very same spot was not unusual. Horseshoe crabs in Japan are almost revered, and the Japanese Association for the Conservation of Horseshoe Crabs has been actively fighting for the species' survival. And yet the animals continue to decline. There is a sad lesson here, from which I hope we can learn. When talking about a species' fate, there is such a thing as the point of no return.

Every time I drive back from Delaware Bay to Boston, I cannot help but wonder what I will find on the bay's beaches next year. Things seem to be looking up for the Atlantic horseshoe crabs, and red knots may be the ones to thank for it.

Dr. Piotr Naskrecki is a research associate at the Museum of Comparative Zoology at Harvard University, where he works on the evolution and systematics of orthopteroid insects. He is also involved in a number of invertebrate conservation projects, including the IUCN Red List assessment of African katydids and the development of Internet-based resources for invertebrate biologists and conservation practitioners. As a writer and photographer he strives to promote the beauty, value, and conservation of invertebrate animals.

The sighting of just four pairs of horseshoe crabs generated excitement at the annual festival in Kyushu, Japan. *Tachypleus tridentatus*, photographed by Piotr Naskrecki.

Xerces Society Opens New Offices in the Midwest and California

As 2009 comes to a close, the Xerces Society continues to expand our core capacity. In just five years we have doubled our staff size and expanded our geographic reach so that we are now engaged in every region of the United States, with staff based in St. Louis, Missouri; Princeton, Minnesota; and Sacramento and Monterey, California. We have also partnered with the University of Wisconsin's Center for Integrated Agriculture in Madison, Wisconsin, to employ a pollinator outreach coordinator to work throughout that state on research and education projects.

These regional offices allow us to do more work, more efficiently. Our expansion has been made possible by support from our members and grants from private foundations and government agencies. In particular, we are grateful to the Bullitt Foundation, the CERES/Greater Milwaukie Foundation, the Columbia Foundation, the CS Fund, the Disney Wildlife Conservation Fund, the Maki Foundation, the New Land Foundation, the Oregon Watershed Enhancement Board, the Oregon Zoo, the Organic Farming Research Foundation, Organic Valley Family of Farms, Panta Rhea, the Turner Foundation, the U. S. Bureau of Land Management, the Natural Resources Conservation Service of the U. S. Department of Agriculture, the U. S. Environmental Protection Agency, the U. S. Forest Service, and the Wildwood Foundation.

We are now working across the United States to educate growers, agency staff, and other agricultural support professionals about ways to create habitat for beneficial insects on farms. We continue to advocate for the protection of bumble bees, freshwater mussels, butterflies, and other threatened invertebrates throughout North America. Thank you for the support that makes this possible.

Xerces Receives Grants for Habitat Protection

The Xerces Society is at the forefront of pollinator conservation, providing advice and information to growers, training agency staff, and undertaking research into the effectiveness of habitat creation. Three recent Conservation Innovation Grants, awarded by the Natural Resources Conservation Service, have enabled us to build our capacity to help both growers and agencies and to more clearly demonstrate the benefits that flow from taking care of habitat.

The first grant is a federal award that allows continuation of a project begun in 2006. In partnership with the University of California at Berkeley, Audubon California's Landowner Stewardship Program, and the Center for Land-Based Learning, the Society implemented habitat restoration projects and UC Berkeley worked to understand how these areas provide for

native bees and ultimately pollination of adjacent crops. Using knowledge gained from these studies, Xerces staff presented dozens of workshops across the state and developed a variety of publications that provide the technical information needed to create pollinator habitat. Capitalizing on these successes, an effort called "Promoting Agricultural Sustainability through Conserving Beneficial Insects" allows UC Berkeley and the Xerces Society to demonstrate the effectiveness of hedgerows as refuges for natural enemies of crop pests. We will use this information to develop guidelines for beneficial insect habitat and engage growers and NRCS staff through workshops across California and the United States.

The second grant was received from the California state office of the NRCS to work in three areas of the San Joaquin Valley to promote pollinator conservation. Through the "Pollinator Conservation in the San Joaquin Valley" project, we will work with local farmers and resource conservation districts to develop and pilot-test guidelines for creating pollinator habitat tailored to the needs of local crops.

Our third successful grant proposal will see our agricultural pollinator program working nationwide. To implement "Native Pollinator Habitat in Diverse Agricultural Landscapes" we will work in California, Oregon, the Upper Midwest, New England, Pennsylvania, and Florida. For this project we will develop pollinator conservation project plans specifically designed for these six different areas. We will work with regional partners to conduct trials of native and pollinator-friendly plant mixes in each area, document the re-

Three recently awarded grants allow Xerces to expand our pollinator conservation work, including creating habitat guidelines for six different regions in North America, in concert with a variety of private and public partners. Photograph by Mace Vaughan.

sults of these trials, and create and disseminate detailed guidelines based on this work.

Partners include the California Association of Conservation Districts, Oregon State University's Integrated Plant Protection Center, the University of Wisconsin's Department of Entomology and its Center for Integrated Agricultural Systems, Pennsylvania State University, the Cape Cod Cranberry Growers Association, the Plymouth Soil and Water Conservation District, and Straughn Farms of Waldo, Florida.

Critical to this project's success is the NRCS's Plant Materials Program. The program's specialists and its twenty-seven plant material centers play a vital role in helping the NRCS complete its mission of natural resource conservation. Six of these centers will participate in the planting of pollinator habitat as part of this project.

The Society's pollinator program staff, based in Portland, Sacramento, and St. Louis, will work to coordinate these efforts to ensure that the project will be successful.

Xerces Society Basic Membership Rate Is Changing

After careful consideration, the Xerces Society is increasing its basic membership rate. This was not an easy decision, but the costs of running a successful nonprofit and producing *Wings* have risen significantly, and membership rates have not changed for well over a decade. Regular and gift memberships will be $30 (or $40 for gift memberships with the *Pollinator Conservation Handbook*), up $5. This rate increase will be effective May 1, 2010. (Renew early to beat the change!) Other membership levels remain the same, including the $15 "Living Lightly" rate for students and those on limited incomes.

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Insects benefit from the protection of habitat whether the purpose is to promote ecotourism or to provide a buffer for filtering pollution entering a stream. Unfortunately, since conservation projects are seldom planned with invertebrates in mind, that benefit is rarely maximized. Photograph of a rain-speckled dragonfly (*Gynacantha tibiata*) by Piotr Naskrecki.

A $25 per year Xerces Society membership includes a subscription to *Wings*.

Our cover photograph shows how, on late-spring nights with a full moon and a high tide, horseshoe crabs (*Limulus polyphemus*) cluster on the beaches of Delaware Bay. Males vie for their chance to mate with the larger female. Photograph by Piotr Naskrecki.