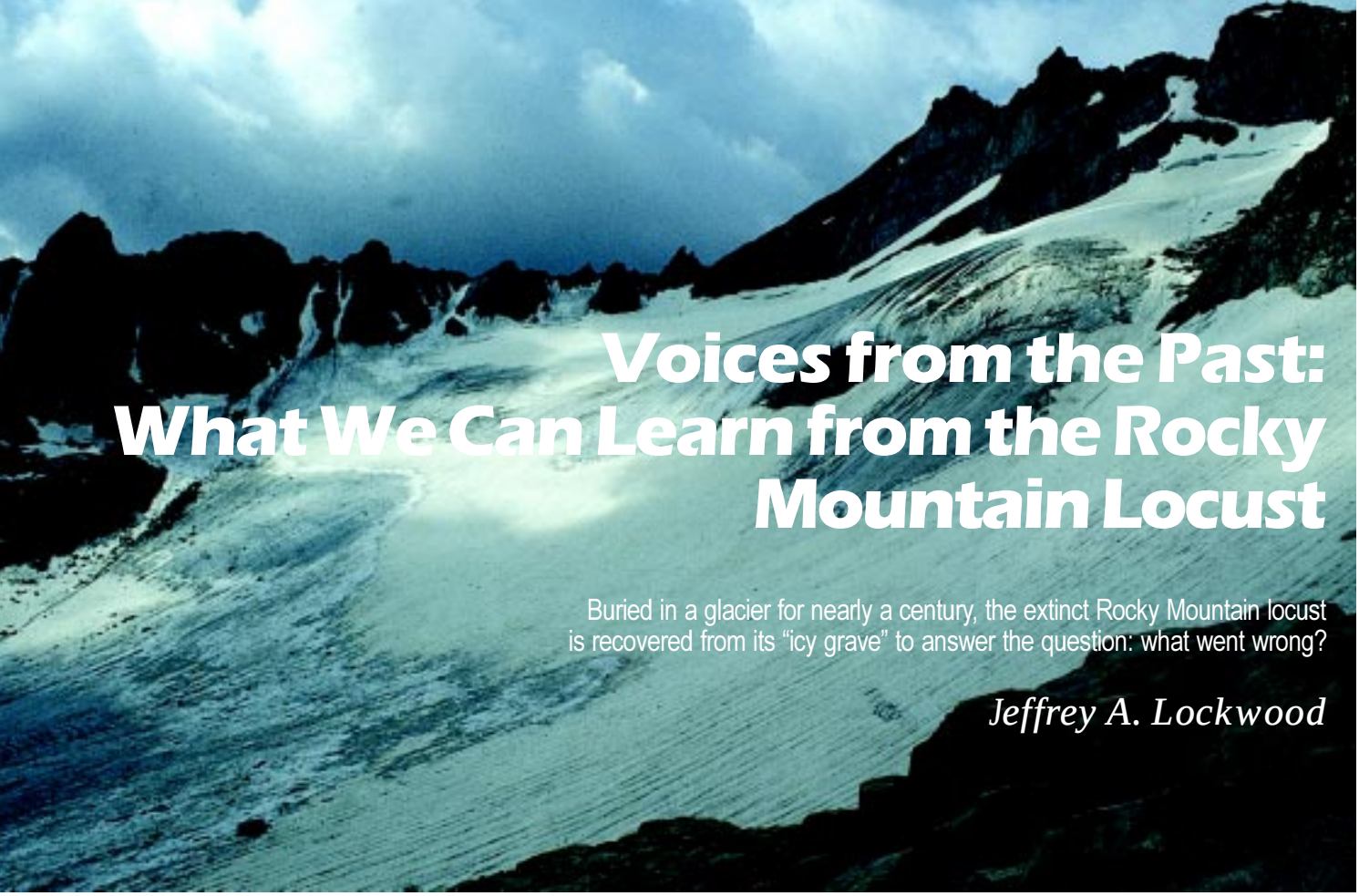


Voices from the Past: What We Can Learn from the Rocky Mountain Locust

Buried in a glacier for nearly a century, the extinct Rocky Mountain locust is recovered from its "icy grave" to answer the question: what went wrong?

Jeffrey A. Lockwood

The tiny, limp body had been violently mangled. Although the corpse had also begun to rot, it was not relegated to anonymity. Having spent the last 4 years honing my forensic skills while searching for precisely these remains, I was able to identify the body as being that of *Melanoplus spretus* (Walsh), the Rocky Mountain locust[1]. This was the first incontrovertible specimen of this creature to be collected in nearly a century. The icy grave in Knife Point Glacier, high in the mountains of northwestern Wyoming, had served as an effective—if somewhat brutal—final resting place. Based on subsequent radiocarbon dating and geological analyses, we surmised that in the early 1600s (approximately the time that the pilgrims were landing at Plymouth) a swarm of Rocky Mountain locusts, probably originating from the river valleys that would one day become part of Yellowstone National Park 100 miles to the northwest, had been swept up the valley and blown onto the ice. Scattered across the ice in a seething carpet of brown-green bodies, some of the locusts may have managed to escape and continue their journey, but millions were immobilized by the cold. In the course of summer melting, rivulets washed them into the crevasses that split the top of the ice field. With time, they were frozen deep in the glacier and slowly transported down the side of the mountain. At a point approximately 750 feet below the crevassed section, the slope flattens rather sharply, and the ice—in a slow-motion version of the rapids that form at the base of a waterfall—becomes turbulent, churning its embedded contents to the surface. For the first time in

[1] The common name currently accepted for this species by the ESA Committee on Common Names of Insects is the Rocky Mountain grasshopper. Perhaps the reluctance to identify this species properly as a locust is related to the intuitive denial that a species with the vigor of the Rocky Mountain locust could disappear (as we shall see) and that we could have unwittingly caused a change of such magnitude. If it was just a grasshopper, then its loss would be a matter of quantitative depletion. With more than 400 other species of grasshoppers in the United States (including dozens in the genus *Melanoplus* alone), the extinction of the Rocky Mountain "grasshopper" is an incremental loss. If we admit, however, that this species was the one and only locust found in North America, then its extinction represents the loss of a continental-scale process found on every other inhabited landmass and its disappearance is a profound, qualitative change.

(above) View across Knife Point Glacier, in the Wind River mountains of northwestern Wyoming. The crevassed portion of the glacier, into which a swarm of *M. spretus* was swept 300 years ago, can be seen in the upper right.

nearly 400 years, the locust bodies emerge into the light.

As a child, I poured over the *Guinness Book of World Records*, plotting various schemes to attain immortality through this authoritative text. None of my plans was ever executed, in large part because my parents lacked the imagination necessary to provide me with the 200 hot dogs, 3 miles of string, or 500 pounds of gelatin needed to fulfill my dreams. As an adult, I finally found my path into the *Guinness Book*. Although you still will not find my name enshrined in this cultural record of human and natural marvels, I submitted and provided the substantiating documents for the record of the "Largest Locust Swarm." In the *Second Report of the U.S. Entomological Commission* (Riley et al. 1880), I came across an account of a swarm of the Rocky Mountain locust that staggers the imagination and bested the old record (a desert locust swarm over Africa) by a substantial margin. According to the first-hand account of A. L. Child transcribed by Riley et al. (1880), a swarm of Rocky Mountain locusts passed over Plattsmouth, Nebraska, in 1875. By timing the rate of movement as the insects streamed overhead for 5 days and by telegraphing to surrounding towns, he was able to estimate that the swarm was 1,800 miles long and at least 110 miles wide. Based on his information, this swarm covered a swath equal to the combined areas of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. If we find it difficult to imagine such a mass of life, it is even more challenging to grasp that less than 30 years after Child's account, the Rocky Mountain locust disappeared forever. What happened at the turn of the last century to drive such a staggeringly abundant species to extinction?

The last, living specimen of the Rocky Mountain locust was collected in 1902, and it had not since been seen in nature—until my colleagues and I recovered the sodden and mangled bodies from Knife Point Glacier in expeditions organized during 1989-1991. We have learned a fair amount about the biology and fate of this species in the last few years, and such is the proper role of science. We even have begun to stretch beyond the raw data and direct interpretations to extract the rudiments of knowledge, recreating the events that likely led to the extinction of this species. But perhaps it is time to seek wisdom, to learn not just *about* the Rocky Mountain locust but to learn *from* this remarkable species.

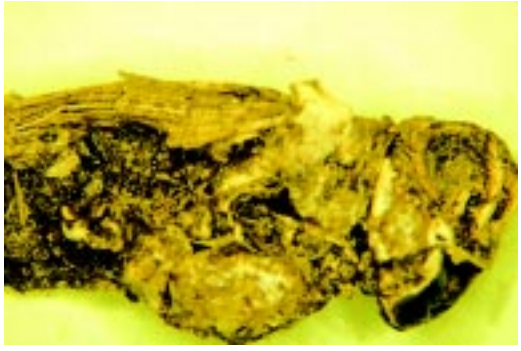
But what can we learn from an insect? In her book, *Harvest of Grief*, Annette Atkins (1984) recounts the devastating effects of the Rocky Mountain locust to the agricultural communities of Minnesota from 1873 to 1878. At the same time that Minnesotans were struggling with this natural disaster, American society was confronting a new concept—the possibility that poverty would require a communal response. As long as fertile land had been available "for the taking" in this country (Native American rights notwithstanding), the only reason for poverty or hunger in an agrarian society was a lack of character, will, and energy. With the gradual closing of the frontier and the beginning of the industrial revolution came the possibility that people could not be held individually responsible for their economic condition. The Rocky Mountain locust forced the people of Minnesota to wrestle with the changing nature of communal obligations and the role of government during a time that marked the transition to the modern world of industrial production, urbanization, and social programs. If we pay careful attention, the Rocky Mountain locust continues to teach us about ourselves; its story offers powerful and troubling lessons for contemporary society.

What happened at the turn of the last century to drive such a staggeringly abundant species to extinction?

A Bull in Nature's China Shop

The loss of biological diversity in the world is proceeding at a startling rate. Although the details can be debated endlessly, we undoubtedly are losing species at a rate greater than a thousand times faster than normal. In other words, a species disappears about every 30 minutes. Most of these losses are in the tropics, where humans are destroying vast swaths of forests. From our vantage point in North America, it is easy to shake our heads, cluck our tongues, and mutter about the

The "transition" portion of Knife Point Glacier, in the Wind River mountains of northwestern Wyoming, where the steep ice fall of the upper glacier flattens into a region in which entombed bodies of *M. spretus* are brought to the surface by turbulent flow.



Lateral view of a dried cadaver (head and thorax) of *M. spretus* extracted from Knife Point Glacier, Wyoming. The head of the centuries-old insect is clearly visible to the right and remains of a wing can be seen on the thorax

Our surveys of grasshoppers in the Yellowstone River valley (the last, undisturbed haunt of the Rocky Mountain locust) have yielded no specimens of this long-lost creature.

senseless destruction rooted in economic myopia. How can these people justify trading in the biological legacy of our planet for a few more acres of crops, which will soon degrade to low-value grasslands? But then, how did our agrarian settlers rationalize the destruction of species? The answer is the same—there is no justification. Both events are tragic accidents induced by socioeconomic pressures, without the actors having malice or forethought.

The Rocky Mountain locust was inadvertently driven to extinction. The most spectacular "success" in the history of economic entomology—the only complete elimination of an agricultural pest species—was the result of unplanned, uncoordinated, and unintentional human activity. Without the power of modern earth-moving equipment or even chain saws, a few thousand people with horse-drawn implements transformed the fertile river valleys of the West. These lands were converted into farms, cattle and sheep were introduced into riparian areas, beavers were eliminated along with their troublesome dams, the streams were diverted for irrigation, and plants and animals from the eastern portions of our country made their way to the West along the corridors we created. But how could these habitat conversions, concentrated into a relatively limited area of the vast Great Plains, have led to the extinction of an insect that during its outbreaks stretched from Canada to Mexico and from California to Iowa? Embedded in this question lies the answer.

During outbreaks, the Rocky Mountain locust could be found in an area of nearly 2 million square miles. But, as with other locusts, in most years the climatic factors necessary to elicit an outbreak did not develop, and the populations eked out a living in highly restricted habitats—the fertile river valleys of the West. These "Permanent Breeding Zones," a term used by the early entomologists, were precisely the lands that the pioneers sought to convert to agricultural production. With the outbreak of the 1870s having collapsed, the Rocky Mountain locust was concentrated in these valleys and, therefore, vulnerable to intense, but spatially limited, habitat destruction. The agriculturalists who arrived courtesy of the transcontinental railroad inadvertently managed to drive their most severe competitor to extinction in a matter of a few years, leaving North America as the only inhabited continent without a locust species. The capacity of the human species to destroy other life forms is not necessarily, or perhaps even usually, a matter of intentional or wanton disregard for Nature. But, one might wonder, at what point does our species become morally culpable for its actions—when can we no longer appeal to being big, dumb, clumsy beasts stumbling through yet another display of fine, living porcelain?

Melanoplus sanguinipes—the extant "lesser migratory grasshopper"—and the species that was hypothesized to be the solitary phase of *M. spretus*. Morphometric and molecular analyses have revealed that *M. spretus* is a true species, not the migratory phase of *M. sanguinipes*

Distribution and movement of *M. spretus,* from C. V. Riley, A. S. Packard, Jr., and C. Thomas. 1880. Second annual report of the United States Entomological Commission. Government Printing Office, Washington, DC.

This question might be answered most effectively if we had been successful in our search for remnant populations of the Rocky Mountain locust in the 1990s. Our surveys of grasshoppers in the Yellowstone River valley (the last, undisturbed haunt of the Rocky Mountain locust) yielded no specimens of this long-lost creature. There was a report several years ago of a number of grasshopper specimens collected in North Dakota that were similar to the extinct species, but it seems that these were probably the migratory phase of an extant, closely related species, *Melanoplus sanguinipes* (F.). But what if we were to find a pocket of habitat still harboring the Rocky Mountain locust? Regulatory officials might well advocate their destruction, as the potential for a return to the swarms of the 1800s would be plausible. Even the vaunted Endangered Species Act exempts pests from protection, so perhaps this remnant population would be accorded the same status as the last vial of small pox. However, in my fantasy scenario, I like to imagine that in an ironic pique, economic entomologists point out that "pest" is a label that can be applied only under appropriate conditions of population density. That is, a population of Rocky Mountain locusts that had not bothered us for a century could hardly be termed a pest, as their numbers have not attained outbreak levels. From the

environmental camp, a few voices might call for protecting these insects as important components of a native ecosystem that is struggling to sustain biotic integrity. There might be some appeals to the Rocky Mountain locust's capacity to serve as a reminder that we must share this world with other species (even those that we have not tamed or controlled), and a few advocates probably would invoke the powerful place of this species in the story of the West and the folklore of America. But in the end, would our decision be any different from that being made by the people of Amazonia or that which would have been made had the early pioneers realized that they had reduced their nemesis to a single locale? If we struggle so mightily with whether we should save the last bits of old growth forest and the few untrammeled tracts of the arctic, what hope would a locust have? What have we really learned about ourselves and our place in the natural world?

Old photograph (date unknown) of a flood plain in the western United States from the slide collection of the University of Wyoming's College of Agriculture. This habitat would have been ideal as a Permanent Breeding Zone or sanctuary of *M. spretus*.

The Science of Nature and the Nature of Science

The Rocky Mountain locust seems to defy the textbook lessons on ecology, preferring to teach us that our simple perceptions, as satisfying as they might be, are illusions. In two contexts, this insect challenges conventional wisdom. Ecosystems often are presented as richly integrated webs of living beings. This provocative conceptualization surely reflects elements of the interdependencies between pollinators and flowering plants, fungi and algae (in the form of lichen), and various other well-established mutualisms. However, when the Rocky Mountain locust disappeared there surely should have been reason to believe that the loss of such a keystone species would have noticeable ripple effects throughout western ecosystems. As far as we know, the extinction of this dominant life form — along with the extirpation of bison, wolves, beaver, and other creatures — had few dramatic effects on the functioning of the immense shrublands and grasslands of the West. The conservationist's argument that we must save species because we need their ecosystem services (as if their role was somehow to assure our well-being and survival) is feeble. In the eastern United States, the passenger pigeon and the American chestnut disappeared without a whimper. At some point, it is conceivable that we might so simplify ecosystems that we could no longer extract resources and services from them, but anthropocentric rationales for conservation (including yet-to-be-discovered cures for our ails) seem a bit disingenuous. These arguments are similar to those speculating on all of the possible financial rewards, official honors, and social recognitions that could accrue from returning a lost wallet. The ultimate, and perhaps only, compelling reason to return a wallet is that it is the right thing to do. Perhaps this also holds for why we ought to look after our fellow inhabitants of the Earth.

My applied entomology textbook suggests that insect outbreaks are evidence of a disturbed or out-of-balance ecosystem. As with a well-behaved child or a good worker, species should refrain from extreme outbursts. This Victorian-era interpretation of the ideal emotional state—or perhaps the legacy of Darwinian uniformitarianism that emerged as a reaction to the Church's reliance on catastrophes to explain the history of the Earth—has lived on in our perception that an outbreak or crash of a population is an unnatural aberration, an indication of a troubled species. The leit motif of the Rocky Mountain locust was its phenomenal flights of reproductive fancy, with manic swarms sweeping over the plains only to subsequently collapse into pockets of exhausted survivors. Evidence of this pattern was embedded in the annual layers of Knife Point glacier, which revealed a pattern of locust outbreaks extending centuries prior to European alterations of the western landscape. Erratic, even explosive, population dynamics do not require anthropogenic disturbance nor do they reflect a dysfunctionality. People, species, and ecosystems can manifest extreme dynamics during times of trouble. But, all too often, we are alarmed by nonconformity not because of concern for another being but because of our self-interest in having a predictable world, our sociopolitical intolerance of radicalism, our economic objective of slow-but-steady growth, and our Protestant ideal of moderation. Sometimes the outburst of joy from a child, the cry of anguish from a neighbor, or the outpouring of life by a species does not need to be "fixed," controlled, or managed but understood, accepted, and honored.

The Rocky Mountain locust also has taught me some interesting lessons about the nature of science in the modern world. Upon returning from the first of many expeditions to glaciers in the Rocky Mountains, we had recovered only some soggy peat moss-like lumps of tangled legs and fragmented wings. Using a few intact structures and a bit of deductive reasoning, we concluded that we had extracted the 800-year-old rotting re-

River flood plain in the foothills grasslands of northern Wyoming. Such a landscape would almost surely support a population of *M. spretus* had this species survived the affects of pioneer agriculture in the late 1800s.

mains of the Rocky Mountain locust (the next three expeditions yielded even less encouraging debris, although we got better at inferring the taxonomy of the fragments). We submitted a paper describing what we had found including the condition of the glacier, the location of deposits, the types of insect parts we had extracted, the radiocarbon dating, and the analyses that led us to believe we had recovered the remains of the Rocky Mountain locust. As the first report of such a study in nearly 50 years, we hoped that the manuscript would be well received. It was rejected. The editor of *Environmental Entomology* at that time explained that the study did not constitute a controlled experiment. Where were we supposed to find a "control glacier" and what experiment could we have done if we had located such a resource? My appeal to the editorial board (the only time I have had the guts to take such a step) was denied with the incisive summary, "You have mistaken natural history for science." It seems that replication, statistical design, and controlled experimentation defined science, at least at that time, for the entomological community. This suggested that initiatives such as the human genome project (decidedly lacking a clear hypothesis), the entire field of cosmology (there is, after all, only one universe), and whole projects devoted to unreplicated discovery (NASA's deep space probes) were not science. It was as if nothing of value was left to describe in the natural world—a remarkable position for entomology, a field in which no more than 10% of its fundamental units of study (insect species) are even known. Even more disturbing was the notion that science required manipulation of the natural world, rather than patient observation or thoughtful description. The Rocky Mountain locust is gone, and no experiment will ever show the course of events that led to its demise, explain the role it played in western ecosystems, or reveal what other species may have perished along with it. Its tale will be told, if at all, to those willing to listen rather than to those demanding answers. In the end, the paper was published in *American Entomologist*, and I have received more reprint requests for it than I have for any paper that involved a controlled experiment. Maybe this is because I do not develop very interesting experiments, but perhaps it is because even scientists find value in stories and yearn to hear the lessons that the Rocky Mountain locust has to teach.

What I have learned from the Rocky Mountain locust suggests other, important biases in the practice of science. That such propensities exist should not be surprising. After all, science is a completely human enterprise richly enmeshed with our cultural, historical, and philosophical predilections. However, the metaphysical assumptions that define what is "real" for science often are not exposed. One of the long-lasting debates surrounding the Rocky Mountain locust has been whether it is truly a species or simply the migratory form of an extant species that no longer swarms (and hence might not be truly extinct but only quiescent). The arguments have been phrased in terms of scientific evidence, but I cannot help but wonder if the debate was grounded in a visceral disbelief that such an enormously abundant creature could actually disappear from the face of the Earth in a matter of a few decades.

Genetic, chemical, and morphological analyses now leave little doubt that the Rocky Mountain locust was a true species. But even this line of argument begs the question of what constitutes a species and raises the specter of our philosophical biases. We usually conceive of the world in terms of material things – for example, a species is a bunch of individuals with the capacity to successfully interbreed. But this presumes the metaphysical truth of materialism—that to be real is to be made of matter. Ecology, however, is beginning to slowly shift focus with tentative explorations of what the world would look like if process, rather than matter, were the basis for reality. What if we defined a species in terms of its life processes? What if we suggested that a thing *is* what it *does*? In this light, the Rocky Mountain locust was an immense, aperiodic process of energy flow, linking life-processes across a continent. If we choose to describe the locust as a process, there is no doubt that this species was extinct in the late 1800s. That is, its ecological role and biological activities ceased well before the last, corporeal manifestation disappeared. This notion of life-as-process might seem unusual in a society in which material existence is primary. But such a perception informs our deepest understanding of life. For example, life-as-process underlies our notion of euthanasia. When a loved one is simply a body, devoid of the capacity to care, respond, or relate ever again in a way that we can recognize as being "them," we understand that they are gone even before they are dead.

Confronting our Mortality

Setting aside the current wave of extinctions, the average species of bird or mammal has a life

expectancy of about 10 million years (Wilson 1988). As such, *Homo sapiens* is still in its adolescence, a time at which individuals of our species pay little heed to their own mortality. As teens, the notion of dying is hopelessly abstract, distant, and irrelevant. Yet, this sense of immortality may contribute to the alarming frequency of accidental deaths, as adolescents shorten their lives by acts of foolish indiscretion, misplaced courage, and irrational risk-taking. Our species seems to manifest these same tendencies at this point in its development. But there are older, wiser voices to be heard in our biological community, including that of the Rocky Mountain locust.

Next year, we can celebrate or mourn the centennial of the material demise of the Rocky Mountain locust, although it seems most likely that 2002 will pass without any recognition of this biologically momentous event. Perhaps our willingness to overlook the passing of this species will be a matter of blissful ignorance for if we understood the story of its extinction, the implications for our environmental complacency would be most disturbing. The *Guinness Book* record swarm of 1875 probably contained in the neighborhood of 10 billion insects, which is disconcertingly similar to the current human population. The simplest and most unambiguous lesson that we can learn from the Rocky Mountain locust is that numerical abundance does not assure future survival. Having reached 6 billion people, we need only look back at the Rocky Mountain locusts that blackened the skies of North America or the enormous numbers of bison that dotted vast tracts of the West to realize that our future as a species is no brighter for our quantity.

But, one might optimistically contend, we are the ultimate generalists, capable of rapidly adapting to an immense range of environmental challenges and occupying new habitats. However, the Rocky Mountain locust might quietly remind us that it consumed no fewer than 50 kinds of plants from more than a dozen families (as well as leather, laundry, and sheep wool when hunger demanded), whereas the overwhelming majority of human caloric intake is derived from just three plant species—corn, wheat, and rice—found in a single family. Moreover, if the body size of the Rocky Mountain locust was increased to that of a human, available records suggest that it would be capable of traveling 36,000 miles, the same distance that our ancestors traveled in the process of circumnavigating and eventually colonizing the planet. It appears that being a highly mobile generalist is little protection against extinction.

There does, however, seem to be a major difference between our condition and that of the Rocky Mountain locust. Although it could sweep across vast regions, this species periodically was restricted to a limited area. The serendipitous overlap of human activity and the remnants of the Rocky Mountain locust demonstrate the hazard of such spatiotemporal bottlenecks. As with the monarch butterfly, whose populations stretch across North America only to collapse back into a few pockets of overwintering habitat each year, the long-term viability of the Rocky Mountain locust was only as great as its most vulnerable link. In a matter of a few days or weeks, a handful of loggers armed with chain saws could effectively eliminate the monarch butterfly by destroying its winter grounds in western Mexico, just as a small contingent of settlers equipped with horse-drawn ploughs, axes, and shovels transformed the fertile river valleys of the western United States. But then, one might wonder, do humans have the equivalent of an ecological bottleneck? Are there places and times into which our species is compressed, and what might we learn from the Rocky Mountain locust about the nature and meaning of these space-times?

Dense population (80 individuals per square meter) of *M. sanguinipes* in southeastern Wyoming showing the severity of the damage that this species can cause to plants. At such densities, this species has a tendency to aggregate and may form large, migratory swarms, as did its close relative *M. spretus*.

The Ecology of "Sacred Spaces"

For a species to become wholly reliant on a place or a habitat requires that it sacrifice other options,

accepting the risks of being profoundly and deeply linked to a landscape. When in the course of evolution such an ecological setting is found, the species comes to flourish in this place. For the Rocky Mountain locust, the fertile river valleys of the West represented a sanctuary, a habitat where they could always find what they needed and persist in the face of adversity. For us, there is one such place, a sociobiological habitat that comprises less than a millionth of the Earth's surface but through which 70% of the human species passes several times a year—our "sacred spaces:" churches, mosques, temples, synagogues, and other religious venues.

The concept of the "sacred" is rooted in the same etymological origin as is sacrifice, which is an act that engenders holiness through loss, suffering, denial, or pain. "Holiness," in turn, is a special condition that is associated with transcendent meaning, so that a place of sacrifice is imbued with importance greater than its physical context. In western society, sacrifice usually is avoided, as we seek security, comfort, and pleasure. However, the existence of suffering has been called the "great mystery" of life, and we continue to struggle with the nature, meaning, and necessity of suffering. And so, our places of worship often reflect stories of sacrifice. Conversely, places of momentous loss often become sacred, such as battlefields at Gettysburg and Little Big Horn, the Edmund Pettus Bridge in Selma, the North Bridge in Concord, or a simple roadside cross adorned with flowers. We also honor "places of sanctuary" where we have found safety amidst a world of turmoil and trouble, such as the hiding place of Anne Frank, Thoreau's cabin site at Walden Pond, or our childhood home. Perhaps our most sacred spaces both remind us of suffering and offer us sanctuary. But what of other species? Does sacrifice or sanctuary define the extraordinary places in their lives? Do these places need to be consciously and intentionally chosen, or can a sacred space emerge in the context of evolution and ecology?

We are reluctant to call the habitats of other species sacred because their sacrifices are not volitional and their seeking of sanctuary is unconscious. But we did not plan for a grassy knoll in Dallas to be the place to lose President Kennedy, we did not intend for a buck-and-rail fence east of Laramie to be the site where Matthew Shepard would be sacrificed to our fear of differences, and we did not design the basements and attics of the houses along the underground railroad to be sanctuaries for runaway slaves. As self-aware animals, we do what we can to honor and protect our sacred spaces, and, perhaps, we should not deny other creatures their own ways of knowing and keeping deeply valued places in so far as they are able. All species have stories of suffering and sanctuary in ecological and evolutionary times. To have arrived in this world is to have risked, lost, groped, huddled, and grasped using those capacities that one's form and function provided. These stories and places of loss and triumph are encoded in all beings; are they less real or less important if they are not maintained by thought or word?

As with the Native Americans, whose cultures eroded with their displacement from sacred lands, the Rocky Mountain locust could not change fast enough to adapt to alternative sanctuaries.

The Rocky Mountain locust, the Native Americans, and the early European settlers of the West found that the serene and lush river valleys provided fresh water, abundant food, and reliable protection from severe weather. Each made sacrifices and probably fought to establish their hold on these fertile valleys, and each understood that these havens would provide a sanctuary in times of difficulty. The locust sacrificed the life of the grasshopper, a more stable, safe, and mundane existence, for the chance to reach levels of abundance that we can barely imagine. As with the Native Americans whose cultures eroded with their displacement from sacred lands, the Rocky Mountain locust could not change fast enough to adapt to alternative sanctuaries. The complex and intimate connections between the land and native species is difficult—and perhaps impossible—to express in objective, scientific terms, but sacred places are central to the well-being of many creatures. Even with all of the "right" conditions of temperature, light, humidity, and diet, animals often languish in zoos. They are unable to express what is missing and perhaps we would be unable to understand, unless we too had experienced the soul-wrenching loss of being forced from a farm or ranch that had been in the family for generations or being driven from a homeland that defined our traditions, stories, and hopes. Even if we had managed to conserve the last of the Rocky Mountain locusts in a zoo, they would no more be their original species than the condors that can never again know the vast, unbroken expanses of land in the California foothills. Unless these insects could once again blacken the skies they would, in fact, become the Rocky Mountain grasshopper.

One Last Lesson

After finding the first small body in the ice of Knife Point Glacier, we began an excited search for more, eventually recovering 130 largely intact remains. Each was catalogued, dried for preservation, and individually stored for future study. On the last day at the glacier, we set a drift net in one of the hundreds of rivulets that rushed down the face of the ice. In just 24 hours, we collected 140 fragmented remains of the Rocky Mountain locust. At this rate, at least 20 million corpses have melted from the glacier since that day in 1990, washing into Dinwoody Creek and perhaps being carried to the Wind River. The glaciers of the Rocky Mountains are retreating at a phenomenal rate. Based on our studies of "Grasshopper" glaciers (several bodies of ice bear this name in recognition of their unusual contents), the glacier north of Cooke City, Montana, has receded 89% since 1940; the glacier in the Beartooth Mountains of Montana is 62% smaller now than in 1956; and the one in Montana's Crazy Mountains has diminished 90% in the last 16 years. Our discovery of grasshopper remains coming to the surface at these various sites is a result of global warming. A century ago, human alterations of the environment caused the demise of the Rocky Mountain locust; and today, the ghosts of these insects warn us of an even more

serious threat to the natural world. As our current environmental crisis exposes our past act of destruction, one can only wonder what else we can learn from the Rocky Mountain locust.

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