PLAGUED BY UNCERTAINTY

The locust wiped out crops and grasslands across the Great Plains during the late 19th century. Is it truly gone for good? **By Paul J. Driscoll**

LOCUST MOTION A modern-day swarm of locusts, likely a species that flew north from Central America, descends on Cancún, Mexico, in 2006. Of the thousands of grasshopper species worldwide, only a dozen can transform into the swarming, voracious locust form. Montana's last infestation came in the late 1800s.

PHOTO ILLUSTRATION BY LUKE DURAN/*MONTANA OUTDOORS*. PHOTO SOURCE: REUTERS/VICTOR RUIZ (MEXICO)

Contrary to what many people believe, the herbivore that consumes the most vegetation on much of the Western landscape is not cattle or sheep, or elk, deer, or antelope. It's the grasshopper.

If that seems surprising, consider that just 150 years ago infestations of a form of swarming, migrating grasshopper known as the Rocky Mountain locust were so severe that almost all vegetation over entire regions was stripped bare. Among the most iconic images of the late 19th-century American West are skies filled with flying locusts descending on pioneer farm families. Row crops, vegetable gardens, horse blankets, and even clothes left on the line were devoured. The horde then lifted off and moved downwind to invade the next hapless community.

Newspapers and prairie journals documented the plagues, which could stretch across the arid West well into the Midwest. A locust swarm in the vicinity of Helena "came in from the north…striking the buildings on the south side of the street, and fell down in such large numbers as to form drifts of hoppers," reads an 1868 account from *The Third Report of the United States Entomological Commission*. One Helenan told a commission representative there were so many locusts that, while driving oxen, he "couldn't see the front yoke."

Such outbreaks could stretch 1,000 miles to the east. Laura Ingalls Wilder, author of *On the Banks of Plum Creek*, wrote about locusts wiping out her family's crops. "A cloud was over the sun," she wrote in 1937, looking back upon her girlhood in Minnesota during the mid-1870s. "The cloud was hailing grasshoppers. The cloud *was* grasshoppers."

A perfect storm of the 1.3-inch-long Rocky Mountain locust (*Melanoplus spretus*) in 1874 is believed to be the largest mass of living insect matter ever witnessed by modern man. Tracked by telegraph, the main flight of that plague measured 110 miles wide and 1,800 miles long, stretching from the southern Canadian plains to the north Texas border, moving easterly toward the Mississippi River on prevailing winds. Periodic outbreaks of locusts on the Great Plains were a major obstacle to agrarian settlement of the prairie in the mid- to late 19th century.

Though it devastated an entire generation of American farmers, ranchers, and pioneers, the Rocky Mountain locust most likely remains today only as a cultural relic. Within 30 years of the 1874 flight, the species had vanished from the North American landscape. The last documented living specimens were observed and collected in southwestern Manitoba, in 1902.

Actual photo of Rocky Mountain grasshoppers (locust form), *Melanoplus spretus,* c. 1870s.

PHOTOS: WIKIPEDIA

Other locust species endure, however. The cradle of agriculture and civilization along the Tigris and Euphrates Rivers in the Middle East is still occasionally visited by flying swarms. Just last year, Egyptian farmers burned tires to divert African desert locusts blown in from the Sudan. Israel was similarly plagued by this species of locust that dates to biblical times.

Yet the Rocky Mountain locust is very likely extinct, perhaps never again to consume a single stalk of wheat. North America has joined Antarctica as the only continent with no resident grasshoppers that take the locust form.

How did that extinction happen? And, even more compelling, has the Rocky Mountain locust truly disappeared?

BAFFLING DISAPPEARANCE

All locusts are grasshoppers, but not all grasshoppers are locusts. Grasshoppers naturally progress through growth phases. Locusts are the ultimate phase of certain grasshopper species that alter their shape, color, and behavior in response to crowded conditions and ecological stresses. Of the 8,000 species of grasshoppers throughout the world, only about 12 are known to become swarm-forming locusts. The Rocky Mountain locust was this form of a grasshopper species native to mountain valleys along both sides of the Continental Divide. When stressed by food shortages and drought, these grasshoppers would change into a climax version of themselves, emerging as locusts with elongated wings needed to travel far from native ranges. Though capable of reproducing elsewhere, the locusts could not survive more than a few seasons outside their native range.

Over the past century, the disappearance of the Rocky Mountain locust—or, more precisely, the locust form of the Rocky Mountain grasshopper—has baffled entomologists and ecologists. The collapse came before the advent of synthetic insecticides such as DDT and happened within an evolutionary blink of an eye.

Jeffrey Lockwood, author of *Locust* and previously an entomologist at the University of Wyoming (where he is now a professor of philosophy), has formulated the most widely accepted explanation. Between major locust outbreaks, he says, the Rocky Mountain locust population would naturally shrink drastically to as little as one-millionth the size of its peak. These insects concentrated in just a few hundred square miles of mountain river valleys, awaiting the next drought or other ecological stressor that would cause numbers to swell again and the insects to swarm. It was from the Rockies that locusts swept across the Great Plains skies into the Upper Midwest to plague Laura Ingalls Wilder's family and neighbors.

As settlers moved West in the late 19th century, these mountain valleys filled with foraging cattle and sheep, and irrigated crops such as alfalfa supplanted native grasses in the bottomlands. Grasshopper egg clusters buried in shallow soils were trampled by livestock, flooded by summer irrigation, and plowed under. Lockwood's theory holds that this coincidental convergence of pioneer agriculture with a vulnerable locust population spread thin among mountain valleys caused *M. spretus* to become extinct.

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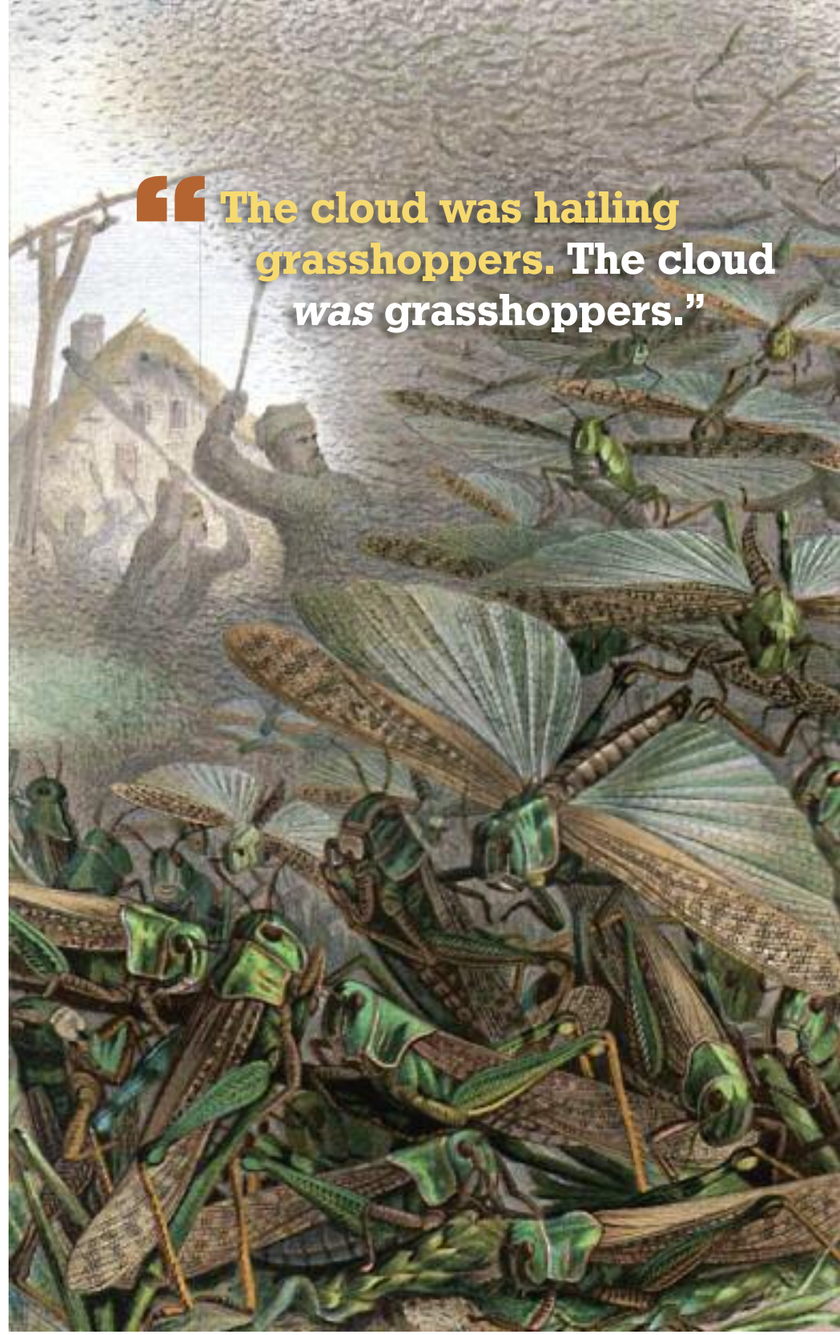
People in the early 1900s were understandably late to grasp the possibility that the Rocky Mountain locust might be gone for good. Because major outbreaks generally occurred every 8 to 12 years, long periods without a regional sighting were not unusual. And when it came to the premier pest of the continent's midsection, out of sight was out of mind. Besides, other grasshoppers emerged to cause problems on rangelands and farm fields, particularly during the drought years of the 1930s. Though not as devastating as locust outbreaks, these infestations were severe enough that a new generation of ranchers and farmers could hardly imagine anything worse.

It wasn't until the mid-20th century that scientists began to wonder why the Rocky



VILLAGE MENACE *Swarm of Locusts*, by Alfred Brehm, 1884, depicts an infestation in Germany. A similar outbreak that devastated American pioneers during the late 19th century was popularized by Laura Ingalls Wilder in *On the Banks of Plum Creek*.

Mountain locust had yet to return. Many entomologists believed that the locust was a particularly gregarious and nomadic form of a common grasshopper—*M. sanguinipes*—also known as the lesser migratory grasshopper. As environmental conditions once again became optimal, they suspected that this familiar grasshopper would transform, like Dr. Jekyll becoming Mr. Hyde, into the crop-devastating locust of old.

Rocky Mountain locust specimen

Were the locusts of the late 1800s in fact a form of *M. sanguinipes*? The only way to know would be to compare DNA. That science didn't exist until the mid-1980s, when Lockwood and colleagues from the University of Wyoming began to look to molecular analysis to unlock some of the mysteries surrounding the disappearance of the Rocky Mountain locust. Finding samples to study was among their biggest challenges. Although once estimated to occur in the trillions, fewer than 500 professionally preserved specimens remain in university and government collections. Most are dried and mounted and lack sufficient tissue for DNA analysis. So Lockwood and his associates turned to the "grasshopper glaciers" in the hope of finding fully preserved specimens. These ice fields, which contain frozen bodies of long-dead locusts and other insects that fell from the skies hundreds of years ago, persist along the most remote upper stretches of the northern Continental Divide.

The researchers first tried Grasshopper Glacier—named by visitors in the early 1900s who observed frozen insects imbedded in the ice—in Montana's Beartooth Mountains. Unfortunately, the glacier had melted so much that old grasshoppers existed only in fragments too small to identify and sample for DNA analysis. After several other false starts, Lockwood finally found, in 1999, whole locusts at Knife Point Glacier in Wyoming's Wind River Range. Over several visits, the crew collected several fully intact specimens and submitted them, along with specimens of currently existing lesser migratory grasshoppers, to a laboratory for analysis.

Carbon dating showed that the locusts were about 400 years old. DNA analysis concluded that the locusts were not a phase of the common lesser migratory grasshopper, as once thought, but a phase of a different grasshopper species entirely—the Rocky Mountain grasshopper. So a new question emerged: Is the Rocky Mountain grasshopper and its locust form truly extinct? And what would happen if this species were discovered, alive, somewhere out there?

Though unlikely after more than a century of its disappearance, a rediscovery of the Rocky Mountain locust could create several problems. Lockwood compares the possibility to current debate over the smallpox virus. Once a deadly scourge the world over, the smallpox virus exists today only in a handful of secure laboratories, such as the Centers for Disease Control and Prevention. Occasionally, calls arise to destroy the remaining virus samples to keep them from falling into the hands of terrorists. Yet many epidemiologists insist the samples be preserved for future vaccine research.

If Rocky Mountain locusts were to be found in hiding, a similar argument would no doubt take place between those wishing to preserve the colonies for scientific research and those demanding the insects' immediate and total annihilation.

WAITING IN THE WINGS?

The possibility of such a discovery is not entirely far fetched. One of the world's most respected grasshopper experts believes that the Rocky Mountain grasshopper may not be extinct after all. He maintains that the species could be living in remote mountain valleys, hardly distinguishable from common grasshoppers.

Daniel Otte, senior curator at the Academy of Natural Sciences at Drexel University in Philadelphia, is a world famous insect expert. He has discovered and named roughly 1,600 species of invertebrates and is the author of a two-volume atlas, *The North American Grasshoppers*, published by Harvard University.

In a series of interviews, Otte told me he thinks some basic element of North American agriculture beginning in the late 19th century may have interrupted one or more of the series of environmental pressures that apparently trigger a final transformation of grasshoppers into locusts. He believes that grasshoppers with locust form potential, like *M. spretus*, could very well survive indefinitely, conveniently hidden among common grasshoppers. He pointed out that the famous African desert locust often exists over decades, and over hundreds of insect generations, as a secretive, largely solitary, and agriculturally benign grasshopper. As pressures from prolonged drought and lack of food build over several generations, those grasshoppers eventually transform into full-blown nomadic locusts. The behaviors of the Rocky Mountain locust may have been similar. "I can't believe *M. spretus* is extinct," Otte said. "But where to look for it?"

LOCKED IN ICE **Right: Jeffrey Lockwood was the first to uncover intact Rocky Mountain locusts from Knife Point Glacier, shown here. Below, a 400-year-old specimen that Lockwood recovered from the ice field.**

CLOCKWISE FROM TOP-MAP GRAPHIC BY LUKE DURAN/*MONTANA OUTDOORS*. SOURCE: U.S. ENTOMOLOGICAL SOCIETY; SCOTT P. SCHELL, UNIVERSITY OF WYOMING; WIKIPEDIA; SHUTTERSTOCK; JEFFREY LOCKWOOD, UNIVERSITY OF WYOMING; SCOTT P. SCHELL, UNIVERSITY OF WYOMING

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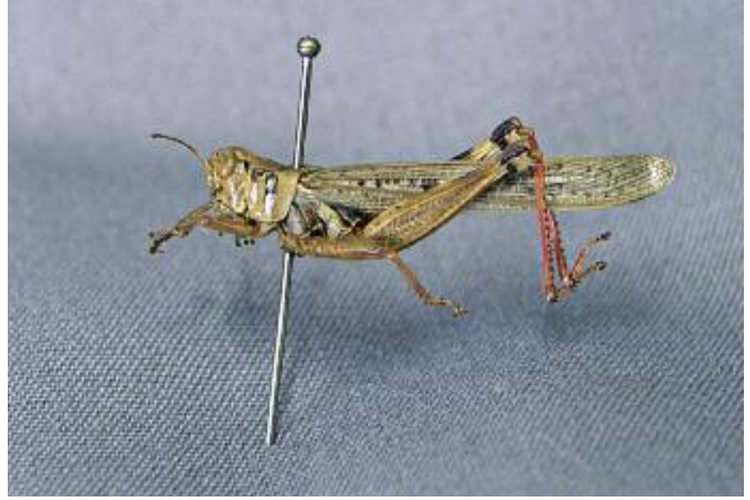

BIDING ITS TIME? **A preserved specimen of the likely extinct Rocky Mountain locust. Note the elongated wings characteristic of the locust form. Some scientists believe that grasshoppers able to turn into locusts may still remain in remote valleys of the Rocky Mountains. If so, most people would hope those swarming insects stay put, never to plague us again.**

Because different grasshopper species are difficult to distinguish in the field, the Rocky Mountain locust could remain hidden among the abundant common lesser migratory grasshopper. One way to find out, said Otte, would be to conduct an extensive survey in likely grasshopper locales across the Rocky Mountains. DNA collected from those grasshoppers could be compared to that in locusts taken from glacial samples.

Whether or not the Rocky Mountain locust remains in the mix, North American grasshoppers are tough insects. They have somehow endured repeated ice ages—not to mention today's powerful insecticides and crops genetically manipulated to thwart pests. Though highly unlikely, it's possible that one grasshopper species with the potential to transform into locusts is still out there, waiting for the right conditions to return.

Grasshoppers and rangeland

U.S. Department of Agriculture agencies have been charged with controlling grasshopper infestations on federal rangeland since 1934. While protecting rangeland in the short term, that work has proved expensive and environmentally harmful. Early hopper controls focused on poisoning grain and other baits. By the 1960s lower-volume applications (less than one-half gallon per acre) of insecticides such as malathion and later carbaryl became the main control methods. Yet even at those levels, the federal Animal and Plant Health Inspection Service (APHIS) cites potential harm to birds and aquatic animals. Sage-grouse are of particular concern. Today, only spot applications are recommended.

Roughly 120 grasshopper species are found in Wyoming and Montana, and many still ravage vegetation. According to APHIS, nearly a quarter of rangeland may be devoured by grasshoppers during outbreaks. Some species specialize on grasses, others on forbs (broad-leaved flowering plants), and others eat a mix throughout different phases of their life. Six or seven species take a major toll on croplands.

The lesser migratory grasshopper (*M. sanguinipes*) is the dominant species over most western rangelands. Major outbreaks of these hoppers occur naturally from time to time, often in response to drought.

Though grasshopper infestations often damage agriculture and farmers' bottom lines, they may be an asset to range health and ranching economics over the long haul, say grasshopper expert Jeffrey Lockwood and APHIS officials. Without question the insects compete with cattle and even wildlife in some years. However, like that of any plant eater, grasshopper excrement is high in nitrogen, which boosts productivity of certain rangeland plants. During outbreaks, hoppers fly more and farther, spreading nitrogen in both their excrement and their bodies as they die after a killer frost. "It's an economic problem versus an ecologic one," says Lockwood. He notes that while most people can afford to take the long-term view of grasshoppers and rangeland health, "unfortunately for ranchers, they have to deal with the short-term economic reality."

Common grasshoppers add nitrogen to soil, improving rangeland vegetation productivity over time. Yet they also compete with cattle and wildlife for grass during the short term.