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SCIENCE

For the Monarch Butterfly, a Long Road Back

By LIZA GROSS NOV. 17, 2014

Dara Satterfield hadn't planned to conduct experiments at the Texas State Fair, but that is where her study subjects showed up last month.

She was still in Georgia when they arrived, so she hurriedly packed her car, then drove all night. As she pulled into the fairgrounds in Dallas the next morning, they were feasting on nectar-filled blossoms of frostweed alongside the Wild West Pet Palooza.

The hungry travelers, like most monarch butterflies that migrate from breeding grounds in the northern United States and southern Canada, had stopped in Texas to consume enough calories to power the last leg of their flight to the oyamel fir forests of central Mexico and survive five months overwintering there.

So many monarchs blanketed the frostweed that Ms. Satterfield, a 27-year-old doctoral student at the Odum School of Ecology at the University of Georgia, allowed herself to hope that one of the world's most celebrated migrations could be revived.

Less than 20 years ago, a billion butterflies from east of the Rocky Mountains reached the oyamel firs, and more than a million western monarchs migrated to the California coast to winter among its firs and eucalypts. Since then, the

numbers have dropped by more than 90 percent, hitting a record low in Mexico last year after a three-year tailspin.

Preliminary counts of migrants this fall are encouraging. “But we’re definitely not out of the woods,” said Ms. Satterfield, who studies human effects on migratory behavior. “One good year doesn’t mean we’ve recovered the migration.”

To make matters worse, she and her graduate adviser, Sonia Altizer, a disease ecologist at Georgia, fear that well-meaning efforts by butterfly lovers may be contributing to the monarch’s plight.

In recent years amateur conservationists have sought to replenish drastic declines in milkweed, the only plant female monarchs lay eggs on. But the most widely available milkweed for planting, the scientists say, is an exotic species called tropical milkweed — not the native species with which the butterflies evolved. That may lead to unseasonal breeding, putting monarchs at higher risk of disease and reproductive failure.

Unlike most migrating species, monarch butterflies employ an improbable strategy that splits their round-trip migration between generations. So their life cycles must be intricately synchronized with those of the milkweed on which they lay their eggs.

Monarchs returning from Mexico reach the Southeast soon after native milkweeds appear in spring, producing the first of up to three generations that breed on new milkweed through summer. When the perennials start dying back in the fall, a final generation of butterflies typically emerges in a sexually immature state. Rather than reproduce when food is scarce and caterpillars might freeze, they fly to Mexico, to wait out the winter.

“The tiny creatures that engage in this big, beautiful migration have never seen the sites in Mexico before and somehow know where to go,” Ms. Satterfield said. “It’s incredible.”

But in the Midwest, which produces half of Mexico’s wintering monarchs, the scores of wild milkweed species among grasslands and farms are fast disappearing.

Nearly 60 percent of native Midwestern milkweeds vanished between 1999 and 2009, the biologists Karen Oberhauser and John Pleasants reported in 2012 in the journal *Insect Conservation and Diversity*. The loss coincided with increased applications of the weedkiller Roundup on expanded plantings of corn and

soybeans genetically altered to tolerate the herbicide. Meanwhile, monarch reproduction in the Midwest dropped more than 80 percent, as did populations in Mexico.

With the loss of native milkweeds that die in the fall, monarchs are encountering tropical milkweeds that are still thriving.

“There’s this huge groundswell of people planting tropical milkweed, and we don’t know what it’s doing to the butterflies,” said Francis X. Villablanca, a biology professor at California Polytechnic University. “We’re all in a rush to figure it out.”

Dr. Altizer fears that when monarchs encounter lush foliage in the fall, they may become confused, start breeding and stop migrating.

“It’s sad, because people think planting milkweed will help,” she said. “But when milkweed is available during the winter, it changes the butterfly’s behavior.”

Butterfly enthusiasts shouldn’t feel bad for planting tropical milkweed, monarch researchers say. But they should cut the plants back in fall and winter. Or even better, replace them with natives. There are native plant societies across the country that can offer advice.

Recent work by Dr. Oberhauser’s lab found that some migrating monarchs are laying eggs in the Southeast when they find tropical milkweed.

Last December, Dr. Villablanca found breeding in overwintering sites in California. “We’re in shock by the number of monarchs that are coming through and laying eggs,” he said.

The reports are worrisome because nonstop breeding on the same plants can unleash a devastating parasite called OE, for *Ophryocystis elektroscirrha*.

Adult monarchs infested with the parasite can carry millions of spores that contaminate milkweed and kill foraging caterpillars. Mildly infected monarchs often can’t fly or reproduce normally, and die early.

It was in the late 1990s that Dr. Altizer, then Dr. Oberhauser’s student at the University of Minnesota, first showed that persistent breeding favors the parasite. In lab experiments, she fed monarchs either tropical milkweed collected from sedentary colonies in southern Florida or native species picked in Minnesota. Tropical milkweed produced much higher infection rates.

She has found similar results in the wild. Her team sampled thousands of monarchs at winter-breeding sites along the Gulf of Mexico and at summer-breeding sites to the north with help from the citizen science group Monarch

Health. Colleagues sent samples from more than 2,000 monarchs at Mexican wintering sites. Those that spent the winter breeding on tropical milkweed had significantly higher levels of parasites.

Since 2002, the prevalence of OE among eastern migratory populations increased nearly threefold, Dr. Altizer has found. She worries that migrants may pick up parasites as they pass through winter-breeding colonies — and even start breeding themselves.

Work from Dr. Oberhauser's lab suggests that this could happen.

Her team reared monarchs from eggs collected in Minnesota under conditions that yield nonreproductive butterflies, then collected roosting fall migrants from Texas. They assigned butterflies to cages with native milkweed, no milkweed or tropical milkweed. No mating occurred in milkweed-free cages.

But a fraction mated when milkweed was present, whether tropical or native. In field experiments, females preferred laying eggs on tropical milkweed in the fall, presumably because it was fresher.

In her own field work, Ms. Satterfield has found far more caterpillars on tropical plants in winter than is typical on natives in summer. The close quarters place them at high risk of serious infection, assuming they don't starve or freeze first.

Not all monarch experts worry about tropical milkweed. "Monarchs utilize an immense landscape in the Eastern U.S., and this plant constitutes a tiny, tiny portion of the milkweeds encountered by monarchs returning in the spring," said Chip Taylor, an ecologist at the University of Kansas who directs the conservation group Monarch Watch. "Should they be there? Probably not. But will they do immense harm? Probably not."

If monarch populations keep falling, the coastal regions could become more important, Dr. Oberhauser said. Migration can limit disease by weeding out the sick and allowing butterflies to leave contaminated plants behind. If year-round milkweed changes the migratory behavior of enough monarchs, she said, "it could have really far-reaching impacts."

So far, evidence that monarchs stop migrating to breed is indirect. "People plant tropical milkweed and then we see monarchs reproducing when they should be migrating or overwintering," Dr. Altizer said. "There needs to be more experimental work done."

And that is why Ms. Satterfield drove all night to catch butterflies in Texas.

The monarchs she collected in Dallas and at another site without tropical milkweed will help her assess the plant's effects at four coastal sites where it is common. She plans to analyze chemicals in the butterflies' wings to distinguish migrants from residents based partly on what they ate as caterpillars. The analyses will show if migrating monarchs pass through the sites. If they interact with resident breeders, it could help explain why disease is increasing among eastern monarchs.

To figure out if migratory monarchs are breeding at tropical milkweed sites, Ms. Satterfield will look for eggs in females and mating behavior in males. She will know if they also abandoned the migration if individuals tagged last month are still there when the migration ends.

No one disputes that loss of milkweed habitat remains the monarchs' biggest threat. But if the population gets smaller, risks once considered less important — like severe weather and disease — could prove catastrophic.

“We’ve learned the hard way with migratory bison and whooping cranes that once we lose a migration, it is close to impossible to bring back,” Ms. Satterfield said. “Protecting the great North American journey of the monarch is crucial now, while we still have a chance.”

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