“Fire” Prevention: Exploring New Ways to Control Grasshoppers and Mormon Crickets

By Dr. Greg Sword, Research Ecologist
USDA-ARS NPARL, Sidney, MT; gsword@sidney.ars.usda.gov; 406-433-9429

The following is the latest offering in a monthly series discussing ongoing research efforts at the USDA-ARS Northern Plains Agricultural Research Laboratory (NPARL) in Sidney, Mont.

People usually don’t pay much attention to grasshoppers (or Mormon crickets) until they become very abundant. During these outbreak periods, however, people really begin to care as these ancient pests consume the crops we rely on for food and the vegetation used by our cattle and other grazers such as sheep and wildlife.

Consequently, outbreaks of grasshoppers, locusts and Mormon crickets are newsworthy events. This past year alone saw a number of major media reports about outbreaks across the world and even here at home in the western United States.

Unfortunately, this is nothing new. The dramatic impact that these outbreaks can have on humans has been recorded throughout history as evidenced by passages in ancient texts such as the Bible and Koran. So why are we still battling the same problems that the Pharaohs once faced? What have we done wrong?

“Fire Fighting”

Historically, humans have responded to outbreaks in much the same way we respond to fire. We wait for them to occur and then try to extinguish them. Sadly, this approach doesn’t prevent damage from being done. As any fire fighter will tell you, the key is prevention.

A much better alternative to dealing with insect outbreaks would be to prevent them in the first place, but until recently, a majority of the research on grasshoppers and locusts conducted over the last 100 years focused on ways to kill them with pesticides. Because of this effort, humans are now quite adept at killing insects, but not at solving the real problem. We can put the fire out, but we still can’t prevent it.

But putting the fire out is no longer enough. Due to the economic costs and wide array of negative environmental effects, treating large areas of land with pesticides to combat an outbreak is at best a last resort, and, in many cases, is no longer an option. Tools to prevent these outbreaks in the first place would provide us with a long-term solution, but developing ways to prevent outbreaks requires us to understand why they happen in the first place. Unfortunately, since killing outbreak pests has historically been the goal of research, we know very little about what actually causes their outbreaks.

"Fire Prevention:" Using Ecological Studies to Curb Outbreaks

This is where the science of ecology comes in. Ecology is the study of the interactions between organisms and their environment. When insect outbreaks occur, it is because some combination of events has taken place that favors their survival and reproduction. Of course, there are a huge number of things that can affect the survival and reproduction of insects. Figuring out which ecological interactions are responsible for the production of outbreaks is the critical task.

As with all animals, grasshoppers must eat to survive. While some grasshoppers primarily feed on grasses, a majority of species can feed on a variety of plants. Just as eating a balanced diet is required for good health in humans, the diet of a grasshopper can also affect its ability to survive and reproduce. Some plants are good, some are bad, but figuring out exactly which plants grasshoppers eat in the wild isn't as easy at it may seem.

During outbreaks it may appear as though grasshoppers eat everything, but that's because competition for food has forced them to eat plants that they normally wouldn't consume. Before an outbreak, which is the period we need to study in order to understand what leads to outbreaks, grasshoppers don't eat everything. In fact, different species have specific preferences for certain plants. Simply observing a grasshopper sitting on a particular plant doesn't mean it actually eats that plant. By the same token, watching it feed on a certain plant doesn't tell you anything about what it has eaten in the past or will eat in the future.

Using DNA to ID Diet Changes: With the assistance of Research Technician Laura Senior, we are developing a technique at NPARL that will allow us to identify the plants that grasshoppers have been eating using plant DNA. We can capture live grasshoppers in the field, extract the chewed-up plants from their guts or feces, and then match the DNA from these plants to DNA from plants that we know occur in the grasshoppers' habitat. Using this technique, we can develop a detailed picture of what the insects eat and how their diet changes over time.

By conducting these studies at a wide variety of sites and at different times during the grasshopper season, we can relate the diet of the different grasshopper species to their overall survival and reproduction. These studies will help us determine the specific plants that play important ecological roles in the lives of grasshoppers prior to outbreaks. Manipulating these critical grasshopper-plant interactions will provide us with ways to negatively influence grasshopper population growth. Habitat management strategies such as grazing management that are also currently under investigation at NPARL may prove to be important tools in altering the grasshoppers' relationships with ecologically important plant species.

Mormon Cricket Band Formation / Migration Studies: The western United States is currently experiencing one of the worst Mormon cricket outbreaks since the 1930s. Mormon crickets aren't really crickets at all. They are actually a type of flightless katydid. During outbreaks, Mormon crickets can gather by the millions to form huge groups, called migratory bands. These bands then move across the landscape and cause severe damage in cropland, as well as reductions in available forage for grazers. Mormon crickets can also be a public safety concern because crushed insects cause dangerous driving conditions similar to an oil slick when they move across highways. They can also foul water supplies when large numbers move into water sources, drown and decompose.

We are conducting two prevention-oriented Mormon cricket projects at NPARL.

First, we are examining the behavior of the insects to try to determine what causes them to form large groups and migrate. If we can understand how they form migratory bands, we can identify the habitats most likely to promote their formation. With this information, we can intervene early in the outbreak process by controlling these local populations to prevent future migration. In the long term, we may be able to manage their habitats in ways that reduce their likelihood of forming migratory bands at all.

Given that we don't yet know enough to prevent Mormon cricket bands from forming, we are also investigating ways to lessen their impact and improve the efficiency of existing management strategies. In collaboration with researchers from the University of Toronto, we are using radio-telemetry and other tracking technologies to monitor the movement of Mormon crickets during their migrations. Due to the large 2-3 gram size of these insects, we can glue small radio transmitters to them and use this signal to track them on a daily basis. The process is very similar to radio-tracking wolves or bears; it's just done on a much smaller scale.

Migratory Models Promising Control Tools: With the information we obtain about the movement of Mormon crickets, we are trying to develop mathematical models that can predict where bands will go. If we can predict their movement, we can determine if a band will threaten important resources and should be controlled at all. If it is decided that control is necessary, knowing exactly where the band will go will allow treatments such as poison baits to be applied with a great deal of precision. We expect to see dual benefits from this research. The total amount of pesticides applied during a Mormon cricket outbreak can be reduced while we simultaneously increase the efficiency of control efforts when they are required.