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Grasshoppers in Utah: General Biology

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GRASSHOPPERS IN UTAH: GENERAL BIOLOGY

This fact sheet is intended for citizens seeking basic information and perspective on the biology of grasshoppers in Utah. It serves as a companion, background fact sheet to Fact Sheet No. 73: Chemical and Biological Control of Grasshoppers in Utah.

Grasshoppers are among the most conspicuous insects that inhabit our state, and are viewed by many as also among the most injurious to our crops and rangelands. In any given year, thousands of acres may be sprayed throughout the state to reduce grasshopper numbers. While at times grasshoppers may inflict intolerable damage if not controlled, we must recognize that only a small number of the many species known to occur in the state cause economic damage. We must also recognize that because these troublesome species often increase in number simultaneously across the landscape, suppression programs may be successful only when they are well-planned and carried out over large acreages. The small rancher or homeowner, inundated with grasshoppers, is likely to have only temporary success when acting alone to reduce grasshopper populations. Unless one is treating an incipient outbreak in a local "hot spot" before the grasshopper infestation has spread over large areas, grasshoppers will continually migrate into a small area from which the pests have been eliminated. For this reason, the federal government, through the USDA APHIS (Animal and Plant Health Inspection Service), assists groups of private landowners with sufficient infested acreage by coordinating large-scale grasshopper spray programs. Nature also often comes to the aid of the beleagered private citizen, as economically damaging grasshopper populations sooner or later collapse even in the absence of human intervention.

Long-term perspectives. Grasshopper outbreaks were characteristic of the Utah landscape long before the Mormon pioneers arrived. Native Americans capitalized on these outbreaks by consuming these insects in large quantities (see D. Madsen below under Additional Reading). Given their frequency and intensity, grasshopper outbreaks probably played important roles in maintenance of the natural ecosystems in which our native fauna and flora coevolved. Such outbreaks now can pose major short-term economic problems for current land uses. But their consequences to sustainable rangeland over the long term are less clear, as these outbreaks may have beneficial effects on such processes as recycling of nutrients and long-term maintenance of plant communities. Another cause for concern over the long run is the possibility that large-scale control programs against grasshoppers, if engaged in too frequently, may inadvertantly lead to more frequent outbreaks, as natural enemies are reduced along with their prey, the target grasshoppers. Recent analyses of grasshopper outbreaks in Wyoming and Montana, for example, lend support for this concern (see J. Lockwood and others under Additional Reading). Together these considerations emphasize the need for careful evaluation and planning in dealing with natural fluctuations in Utah's grasshopper populations.

What is a grasshopper?

A grasshopper is an insect with chewing mouthparts closely related to true crickets, cockroaches, walking sticks, and praying mantises. Two major groups occur in North America: the short-horned and long-horned grasshoppers (short- and long-horned refer to the length of the antennae). The former group (technically known as the family Acrididae) includes the old world locusts highlighted in the Bible, and is generally the group laypeople have in mind when speaking of grasshoppers. The short-horns or acridids include most of the injurious species of public concern in Utah; one notable exception is the Mormon Cricket, which is a long-horned grasshopper (and not a true cricket; see H. Evans and C. McVean below under Additional Reading). Other long-horned grasshoppers (technically known as the family Tettigoniidae) include such members as katydid, cone-headed and meadow grasshoppers, which usually pose little economic threat. This bulletin will use the term grasshopper to refer, in particular, to the family Acrididae, the short-horned grasshoppers.

Habits and life cycles of grasshoppers

There are three major groups (subfamilies) of these grasshoppers in Utah: the slant-faced grasshoppers, the band-winged grasshoppers, and the spur-throated grasshoppers. The slant-faces, as their name implies, generally have angled faces and long, thin bodies that enable them to blend into the grassy vegetation with which they are generally associated. The banded-wings are the conspicuous hoppers with often brightly colored hindwings that snap and crackle as these insects fly short distances. The banded-wings are especially common in open desert and scrub; they blend in well with their brown and grey surroundings when they snap their wings shut and rest motionless upon the ground. The spur-throats include most of our injurious species, including for example the lesser migratory and the red-legged grasshoppers. Their name derives from the tubercle projecting between their front legs.

Most grasshoppers in Utah have one generation each year. Eggs in most species are laid in the soil in summer and fall, and hatch the following spring. The eggs are laid in groups held together in a pod formed from a sticky secretion to which loose soil becomes bound. Embryonic development begins soon after the egg is laid, but is arrested during the winter until resuming as damp soil warms in the spring. The immature grasshoppers (called nymphs) typically pass through five stages (nymphal instars), shedding their exoskeletons (molting) at the completion of each stage, before becoming reproductively mature adults. Grasshopper nymphs have only wing buds and cannot fly; in most species, the adults have functioning wings and are capable of flying great distances. It is the later (especially fourth and fifth) nymphal instars and adult grasshoppers that are most voracious and are responsible for most economic damage.

Each of the many grasshopper species inhabiting Utah has its own unique life history, including habitat and food preferences. While grasshoppers are often depicted as indiscriminate feeders, in fact individual species show marked preferences for certain kinds of plants. Indeed, some species are so specific as to feed almost exclusively on only one or a few closely related species of plants. As a broad generalization (of course, with exceptions), slant-faced grasshoppers feed primarily or exclusively on grasses, spur-throats feed primarily on forbs (i.e., herbs other than grasses), while band-winged grasshoppers have intermediate feeding habits. These dietaries are reflected in the basic morphology of the grasshoppers' mouthparts: grass-feeders have ridged, flat-topped surfaces on their mouthparts to aid them in grinding down their tough, silica-rich foods, while forb feeders have large cusps to tear and shred their more

fleshy, leafy foods. It is critical in assessing the potential for economic damage to identify the species (and associated food preferences) involved when large grasshopper numbers occur in rangeland, roadside and fence row vegetation adjacent to cropland. The species posing most threat to Utah agriculture are, generally speaking, grasshoppers with broad diets (often including both grasses and forbs) and broad habitat preferences. These species are capable of building over one or several years to high numbers in local areas, and especially as winged adults, migrating considerable distances as the local vegetation is consumed.

Why and when do grasshoppers outbreak?

If only we knew! Unfortunately the forces behind population dynamics (changes in density over time and space) remain all too mysterious despite valiant efforts of many researchers over many years. Weather, natural enemies, and changes in the quantity and quality of the food plants combine in complex ways to make the dynamics of grasshopper populations hard to predict.

Variations in weather are well-known to lead to differences in survival and reproductive success of grasshoppers that can result in tremendous fluctuations in numbers. Generally speaking, warm dry weather favors hopper survival, but enough rainfall is also required to ensure egg development in the spring and adequate quantities of green food thereafter for maturing nymphs and egg-producing adults. In areas of the world such as the northern Great Plains where moisture is typically sufficient, grasshopper outbreaks are generally associated with hot, dry weather. In more arid climates, such as the desert grasslands of Arizona, outbreaks may be favored by unusually cool and moist weather. Years with abundant winter and spring moisture followed by warm, dry summer weather may often provide the ideal mix to promote population build-up.

Weather may affect grasshoppers both directly and indirectly. Thus, cool wet weather may be detrimental to "cold-blooded" grasshoppers simply because it prevents them from feeding. It may also favor infection by fungi and other disease-causing organisms, which are often implicated in the collapse of grasshopper outbreaks. It may affect grasshoppers indirectly through its complex effects on the population dynamics of other natural enemies, such as the numerous species of predatory and parasitic insects that attack grasshoppers. Conversely, warm, dry weather may indirectly favor grasshoppers by causing their host plants to break down proteins into constituent amino acids to maintain water balance. Such changes in the host plant may make it a better source of nutrition to grasshoppers, which can assimilate precious nitrogen more readily when it occurs in "free" amino acids rather than occurring in such acids linked together as plant structural proteins.

The potential complexities involved in grasshopper population dynamics are daunting. It should not be surprising that as yet efforts to model and predict the rise and fall of grasshopper populations have had only limited success. The need for careful research, conducted painstakingly over many years, remains as great as ever as we strive to improve our understanding of why, when, and how grasshopper populations rise and fall.

Additional Reading (copies can be provided by the USU Department of Biology; please enquire through the County Extension Office)

Evans, H.E. 1985. The pleasures of entomology. Smithsonian Institution Press. Washington,

D.C. (Chapter 5 of this delightful book is devoted to an engaging account of the biology of the Mormon Cricket, other chapters are devoted to equally fascinating insects generally well-known to the public.)

Hewitt, G.B. and J.A. Onsager. 1982. Grasshoppers: yesterday, today, and forever. Rangelands 4: 207-209. (The authors review the biology of grasshoppers, and potential forage losses from and control efforts against these insects in the western United States.)

Lockwood, J.A., W.P. Kemp, and J.A. Onsager. 1988. Long-term, large-scale effects of insecticidal control on rangeland grasshopper populations (Orthoptera: Acrididae). Journal of Economic Entomology 81: 1258-1264. (The authors present evidence that grasshopper outbreaks have occurred more frequently in response to more intensive insecticide spraying in Wyoming than in adjacent counties in Montana, perhaps because overly intensive use of insecticides upsets control by grasshopper natural enemies.)

Madsen, D.B. 1989. A grasshopper in every pot. Natural History 7/89: 22-25. (Recent archeological studies near the Great Salt Lake have revealed that Great Basin hunter-gatherers ate large numbers of grasshoppers, especially during natural outbreaks.)

MacVean, C. 1990. Mormon crickets: a brighter side. Rangelands 12: 234-235. (The author's research suggests that in open rangelands, in contrast to crops, outbreaks of Mormon crickets may be far less damaging to forage vegetation than previously thought. Adult crickets, in fact, primarily consume sagebrush.)

Pfadt, R.E. 1988. Field guide to common western grasshoppers. USDA APHIS/Wyoming Agricultural Experiment Station Bulletin 912. 25 pp.

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