VII.15 Grasshopper Habitat Manipulation

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Introduction

Managing grasshopper populations through habitat manipulation (changes) is poorly understood and consequently, seldom considered. However, it may be a very reasonable strategy given the diversity of grasshopper species found in any single habitat (vegetation type) and the large area that pest managers must deal with in the rangelands of the Western United States. In fact, habitat management, such as destruction of prime egg-laying sites, was one of the earliest and most common forms of grasshopper control (Pfadt and Hardy 1987).

Habitat manipulation would seem particularly useful today because many grasshopper outbreaks occur in habitats that have been changed by human activities. Overgrazing, modified fire regimes, and introduction of exotic plants on American rangelands have led in some instances to replacement of relatively grasshopper-resistant native vegetation with vegetation that supports more frequent grasshopper outbreaks. An example may be when the native, perennial sagebrush/bunchgrass of the Intermountain regions are replaced with annual grasses and forbs. Therefore, restoration of the land's productivity can go hand in hand with grasshopper control by habitat manipulation.

The potential use of habitat manipulation as a control strategy is apparent when the following two possibilities are taken into consideration: (1) Most grasshopper species do not reach outbreak levels or cause economic damage (Pfadt 1988). What if managers could replace species that reach outbreak levels and cause economic damage with species that do not? Species substitution on this scale might be possible through habitat manipulation. (2) Even if outbreak species cannot be totally replaced, habitat manipulations may reduce their abundance and lessen the likelihood of outbreaks.

To address these habitat manipulation prospects, we can provide some potential examples but cannot present general strategies because this issue has not been broadly examined. When we refer to habitat manipulation, we are largely concentrating on vegetation changes because both the absolute and relative abundance of grasshoppers are related to vegetation (Kemp et al. 1989, Belovsky and Slade 1995). Vegetation changes can have a variety of impacts.

Fostering Natural Enemy Abundance

If pest managers could change the vegetation, doing so might increase natural enemies of grasshopper species that reach outbreak levels. Such increases could reduce abundance of the pest grasshoppers and the frequency of outbreaks (Belovsky and Slade 1993).

Predators as Grasshopper Population Regulators.— Predators, especially vertebrates such as birds and rodents, are potentially important in regulating grasshopper numbers under certain circumstances (see chapter VII.14). It may be possible by habitat manipulations to extend the circumstances under which predators effectively limit grasshopper numbers. First, greater vegetative cover may increase the numbers of these predators by protecting rodents and bird nests from their predators. Second, less vegetative cover (open *vs.* thick areas) can make grasshoppers more vulnerable to predators (fig. VII.15–1). The figures in this illustration were measured by placing tethered grasshoppers in areas of different vegetative cover and determining how many were killed by predators.

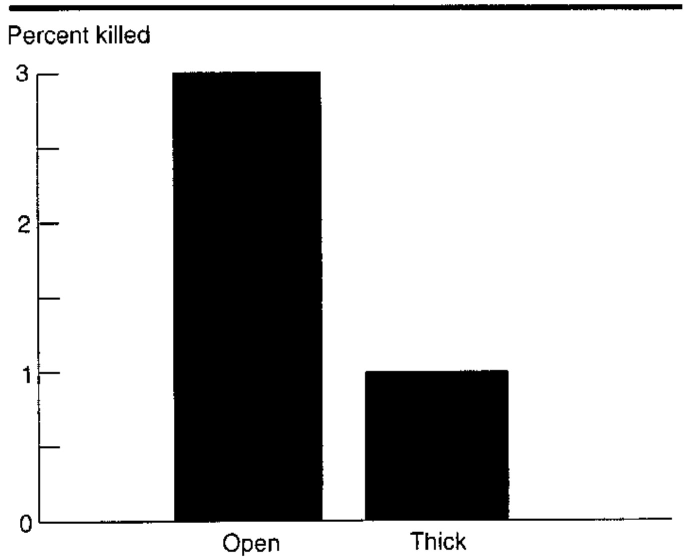

Figure VII.15–1—Comparison of the effectiveness of predators at killing grasshoppers in grasslands with more than 40 percent bare ground (open) versus less than 20 percent bare ground (thick) in western Montana.

1996-2000. In: Grasshopper Integrated Pest Management User Handbook (Gary L. Cunningham and Mike W. Sampson, tech. cords.). Technical Bulletin 1809. Washington, DC: USDA, APHIS.

The effects of habitat on predation might seem in opposition—on one hand increasing cover for birds and on the other hand decreasing cover for grasshoppers. However, on rangelands, the management trend is to make them more uniform. For example, overgrazing tends to reduce the height of vegetation; while this factor can make the grasshoppers more vulnerable to predation, there are now fewer predators to take advantage of the more open conditions for hunting, so the potential for greater predation on grasshoppers is seldom fully realized.

Manipulation might restore some of the natural variation in the habitat. Changes of that sort might be accomplished by providing small patches of thick cover for protection of the grasshoppers' predators, especially bird-nesting sites. Simultaneously, a pest manager might maintain habitat openness or even reduce cover in the intervening larger areas between patches of thick cover to increase the effectiveness of the predators in capturing grasshoppers. In doing this, a manager might be able to increase the predators' numbers and efficiency and thereby enhance the ability of predators to limit grasshoppers when predators otherwise might not be effective.

Parasitoids and Parasites.—As with predators, parasitoids and parasites might have their numbers and efficiency enhanced by manipulating the vegetation. For example, mites (parasites that attach themselves to a grasshopper's exoskeleton and "suck" the grasshopper's "blood") can dramatically reduce grasshopper survival and egg production, but these parasites generally do not appear to reach high enough densities to limit grasshoppers (see chapter I.9).

The inability of mites to reach high enough densities to limit grasshopper populations appears to be due in many areas to soils that have reduced drainage. Poor drainage should not be confused with moist conditions, a rarity in most western rangelands; poor drainage pertains to soils, such as clays, that tend to hold moisture longer. As with cover for predators, a manager might consider creating patches favorable to mite production that are interspersed throughout the larger area. Changing vegetation composition or cover or even providing small areas of better draining soils in small areas could achieve this end.

Reducing Grasshopper Food Abundance

In many areas of western rangeland, food abundance may be limiting grasshopper populations (see chapter VII.14). It may be possible to diminish food abundance using habitat manipulations in ways that will not negatively affect the forage available to livestock.

Increasing Competitors' Abundance.—If other species compete with the pest grasshoppers for food, then increasing the abundance of these competitors might reduce the abundance of pest grasshoppers. Unfortunately, enhancing the numbers of competitors might simply substitute one pest for another so that the forage available to livestock is not enhanced. However, limiting pest grasshoppers by reducing their available food through consumption by competitors, without simultaneously diminishing the forage available to livestock, might be accomplished under two conditions. First, livestock grazing might be used to reduce grasshopper numbers; this substitutes livestock consumption for grasshopper consumption of the forage. Second, habitat manipulations might be used to replace pest grasshopper species with species that do not reach outbreak levels, especially if these other species do not reduce the forage for livestock to as great a degree as the pest species.

Different studies have disclosed that livestock grazing decreases grasshopper densities (Hutchinson and King 1980; Jepson–Innes and Bock 1989; Capinera and Sechrist 1982; Fielding and Brusven 1995), increases densities (Coyner 1938 unpubl., Nerney 1958, Anderson 1964, Holmes et al. 1979), and has no effect (Miller and Onsager 1991) on grasshopper densities. In cases where grazing reduced grasshopper abundance, it appeared that the grasshoppers encountered a shortage of food. In cases where grazing increased grasshopper abundance, it appeared that the grasshoppers either responded to decreased cover (see thermal cover, below) or increased forb abundance (see vegetation changes, below). All of the above studies found that the grasshopper species composition changed with grazing. Grazing effects are more fully discussed in chapter V.1.

Grasshoppers that compete with the pest species might be encouraged by management to reduce the pests' abundance. This option would be useful if the competitor emerges earlier than the pest, so that survival of the pest species' nymphs is reduced. In addition, it would be particularly useful if the earlier emerging competitor cannot survive later into the season, when the pest would otherwise be most abundant; this scenario would allow the vegetation to regrow after consumption by the competitor.

An example is provided by the nonpest early-season grasshopper *Melanoplus confusus* and the pest late-season grasshopper, *M. sanguinipes,* in the Palouse prairie of western Montana (Belovsky 1990 unpubl). As fourth- and fifth-instar nymphs and adults, *M. confusus* dramatically reduces the survival of *M. sanguinipes* in experimental populations by competing for food plants (fig. VII.15–2). The *M. confusus* adults quickly die off in early July, and the vegetation regrows because rains in most years permit continued growth. The negative effect of *M. confusus* on *M. sanguinipes* is illustrated by *M. sanguinipes* being able to reach the same densities in the experimental mixed populations as in experimental pure populations, when *M. sanguinipes* are placed in the experiments after *M. confusus* dies off (fig. VII.15–2). Unfortunately, under natural conditions, *M. confusus* populations are generally too low to achieve this effect.

Encouraging *M. confusus*.—A straightforward means by which a manager might increase *M. confusus* numbers is not apparent.

Manipulating Plant Species.—The relative abundance of different plant species might be manipulated to reduce the abundance of those species that are more important to the pest grasshoppers than they are to livestock. While grasshoppers and livestock consume many of the same plant species and thereby compete, grasshoppers do not consume identical sets of food plants. A good example of this manipulation might be to reduce the abundance of annual grasses and forbs and to increase the abundance of perennial grasses and shrubs. Many pest grasshoppers, especially in the spurthroated group (Melanoplines), seem to thrive with the annuals, and livestock are capable of foraging on the perennials. But changing vegetative composition can also modify cover and plant abundance.

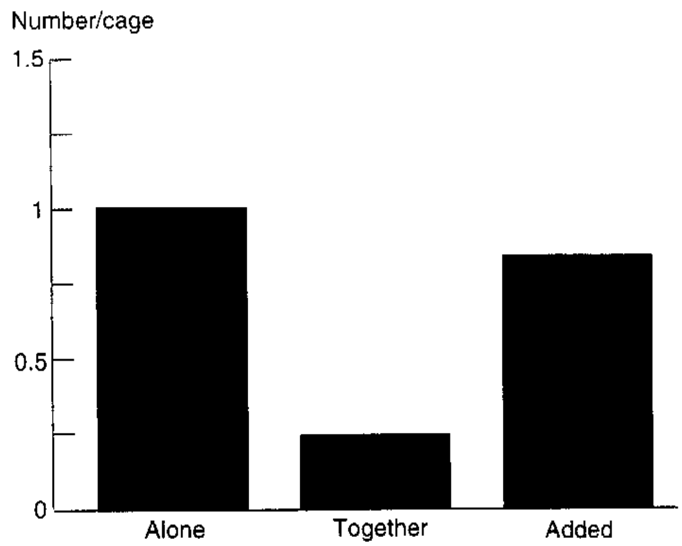

Figure VII.15–2—The densities attained by *Melanoplus sanguinipes* in experimental field populations (cages) when by itself (Alone), when with *M. confusus* (Together), and when it is added after *M. confusus* dies off later in the summer (Added).

Therefore, habitat manipulations that modify the relative abundances of plants need to be weighed against changes in these other factors and how they affect both pest and livestock.

Changing Grasshopper Thermal Cover

Vegetation provides more than food—it also provides thermal cover for grasshoppers. Grasshoppers are able to consume a greater quantity of food when they are in favorable thermal conditions. Under favorable conditions, a grasshopper can process more food through its digestive tract and has more time to consume foods. Greater food consumption leads not only to greater immediate losses of forage resources on rangelands but also to larger grasshopper populations by increasing the grasshoppers' survival and reproduction.

Thick vegetative cover for a grasshopper may lead to a thermal environment that is cooler than optimal, reducing grasshopper survival and reproduction. The same effect can be caused when there is too little vegetative cover for a grasshopper and the environment is warmer than optimal. Therefore, land managers might manipulate vegetative cover to diminish grasshopper feeding, and thereby, their survival and reproduction.

Possible Methods for Habitat Manipulation

We have presented a series of ecological processes that habitat management might be able to exploit to reduce pest grasshoppers. However, methods are required to modify the habitat and thereby change the ecological processes.

A number of methods have been investigated without reference to how they changed ecological processes. It has been demonstrated that the use of herbicides on rangelands has little effect on grasshoppers, while furrowing, scalping, and interseeding grazing lands can reduce grasshopper numbers dramatically (Hewitt and Rees 1974). Researchers are not sure if furrowing, scalping, and interseeding change predation cover, thermal cover, plant composition, or all of these factors.

One method that has been investigated at least partially from the perspective of ecological processes operating on pest grasshoppers is fire on rangelands. It primarily operates to change the composition of the vegetation and, thereby, grasshopper food abundance. However, fire can produce different outcomes on pest grasshoppers. Under some conditions, fire enhances grasshopper numbers and in others, decreases them. For example, intense fires destroy sagebrush/native bunchgrasses, enhancing annual plants, which are favored by pest grasshoppers. On the other hand, "cool" fires enhance the abundance of native bunchgrasses and, thereby, decrease pest grasshoppers. Likewise, livestock grazing can be used to manipulate vegetation composition, but as with fire, different grazing intensities result in different outcomes.

Reseeding areas with crested wheatgrass after native bunchgrasses have been destroyed can reduce pest grasshopper abundance but not to the extent that native bunchgrasses can. Therefore, methods for restoring native rangelands may have considerable potential for grasshopper pest management.

A greater variety of these methods needs to be investigated in a range of different habitats. However, these methods may require greater than normal monitoring by managers. For example, grazing and fire both require the manager to assess intensity carefully, and doing that can be difficult as weather conditions dramatically change the vegetation from year to year.

For example, management by grazing might require the manager to manipulate stocking rates much more than ranchers traditionally have undertaken, or in ways that do not maximize the rancher's income. In addition, habitat manipulations must be evaluated in terms of their impacts on wildlife, recreation activities, and the maintenance and restoration of native vegetation. Habitat manipulations have not been adequately investigated as a viable pest-management strategy for grasshoppers, but manipulations may have great potential to reduce grasshopper-caused damage with fewer negative impacts on the environment.

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