VI.3 Applying Economics to Grasshopper Management

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Economic considerations are a major part of grasshopper management. Rangeland grasshopper control programs, as well as other pest management strategies, use the concepts of economic threshold (ET) and economic injury level (EIL). The ET is defined as the pest population (density) that produces incremental damage which is just equal to the incremental cost of control (Headley 1972). Pedigo and Higley (1992) advance an identical definition. Viewed from this perspective, the damage caused by the pest must be at least as great as the cost of treatment before the ET is reached. The EIL and ET are related concepts. For some pests, observations of earlier life stages can define an ET for an EIL density of a subsequent life stage. For grasshoppers, however, density surveys are completed and ET evaluations are made based on those surveys.

For many years, grasshopper control programs followed an administrative guideline intervention level of 8 grasshoppers/yd^2 as suggested by Parker in 1939. However, the Grasshopper Integrated Pest Management (GHIPM) Project found the ET to vary, depending on a number of conditions in the range forage, grasshopper, and ranch system. Because the ET for rangeland grasshoppers varies with conditions, the GHIPM Project developed a microcomputer-based decision-support system (Hopper) to help those responsible for grasshopper control programs make realistic estimates of the ET. This chapter discusses the physical, biological, and economic rationale that determines the ET.

Evaluating Benefits

There is a long history of public support for control of rangeland grasshoppers. Individual efforts cannot control widespread grasshopper outbreaks. However, there also is a public benefit from protecting rangelands from serious outbreaks of grasshoppers. Public rangeland has many uses. Ranchers lease rangeland for domestic livestock grazing, the traditional economic use. Rangeland also supports a diverse population of wildlife, provides recreation and open space, protects soil from erosion, and contributes to the watershed for rivers and streams. Rangeland grasshoppers eat and destroy forage that livestock and range-consuming wildlife could use. When grasshopper infestations occur on rangelands, ranchers relying on those lands for livestock grazing incur economic losses. Reducing the density of grasshoppers reduces losses to ranchers. The difference in ranch net returns with and without grasshopper treatments is the basis for the benefits calculation. If grasshoppers exceed the ET and land managers or agencies apply treatments, those treatments can limit the reduction in the ranchers' net returns.

The GHIPM Project's decision-support system, Hopper, includes an economics component that evaluates damage reduction (limiting the decrease in net returns for ranchers) for each of the approved grasshopper treatment alternatives. The damages abated are the benefits resulting from the treatment program. The estimate of damages abated likely is unique for a typical ranch and makes use of the type of range being considered for grasshopper control programs.

Typical Ranches

Because it would be very costly to estimate the damage caused by grasshoppers for each ranch using a grasshopper-infested rangeland, we estimated benefits from grasshopper treatments for "typical ranches" on the major range types for which a version of Hopper is available.

Typical ranches reflect the characteristics of ranches in an area. They are typical with respect to rangeland productivity, livestock on the ranch, grazing management practices, and livestock management practices. To define typical ranches, we interviewed ranchers in an area to identify the common practices. The typical ranch became the barometer to evaluate benefits of grasshopper treatment programs for a given range type. Consequently, typical ranches could be indicators of the extent of the economic impact of grasshoppers on the net incomes of ranchers using that range-type.

Suppose that, as a land manager, you are responsible for making the decision about whether or not to conduct a grasshopper control program in a given area. You know the typical ranch in your area is a cow–calf operation that uses public grazing land along with intermingled deeded rangeland. An economic decision model for the typical ranch is available to show the options you can choose among for dealing with an infestation of grasshoppers.

Here are some management strategies you may consider.

- Have a reserve of hay to supplement grazed forage, which may vary with climate or grasshoppers;
- Find additional grazing land to lease;
- Use crop residues to replace forage lost to grasshoppers;
- Change livestock management practices to reduce forage requirements (such as shift from a cow–yearling to a cow–calf marketing strategy, purchase rather than raise herd replacements, or reduce the size of the cow herd through culling);
- Purchase hay; and/or
- Initiate grasshopper control programs.

The economic decision model lets you consider simultaneously which of these options will result in the least reduction in the expected net returns from the ranch. You choose the option least costly to the ranch, based on your current expectations about prices and costs.

The economic decision model for the nine typical ranches is incorporated into Hopper. In Hopper, the decision model for the typical ranch works with two other components that consider the physical and biological systems present on the ranch. One component estimates the growth of rangeland forage, given soil type(s), temperature, precipitation, and related climatic variables. A second component estimates grasshopper population dynamics and the amount of forage that grasshoppers eat and destroy on the ranch.

The grasshopper population dynamics component of Hopper works with the rangeland forage growth model to predict how much forage will be available for grazing animals. Because some types of wildlife also use rangeland forage, the amount of grazable forage available to livestock depends on how much forage grew and how much remains after grasshoppers and wildlife have eaten.

The grasshopper population dynamics component of Hopper also lets you consider each of the approved treatment options available. Treatment options are determined by physical and biological conditions as well as by the cost effectiveness of the options. Each option comes at a different cost and behaves differently in its timing and effectiveness on grasshoppers. The economic decision model for the typical ranch uses these other two components of Hopper to evaluate the nontreatment adjustments available to the rancher along with the cost and effectiveness of alternative treatments.

To evaluate the benefits, Hopper compares the ranch net returns with no treatment to the ranch net returns for a given treatment at various grasshopper densities. Treatment benefits are the difference in ranch net returns between a treatment option at a given grasshopper density and ranch net returns with the no-treatment option. At low grasshopper densities, ranchers may adjust their grazing or livestock herd management to the loss of forage from grasshoppers. As grasshopper densities increase, losses in net returns also increase. At some point, the density of grasshoppers approaches the ET, and the use of treatments becomes economically justified (fig. VI.3–1).

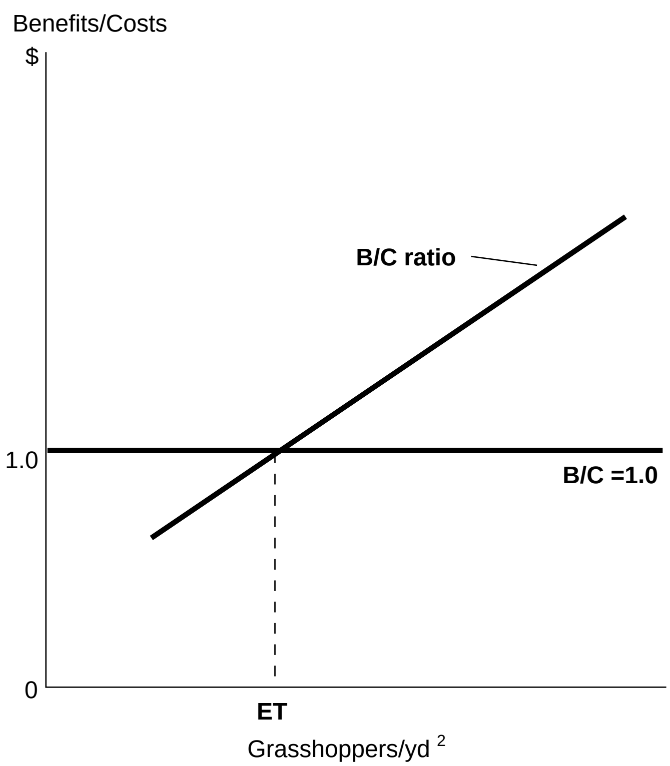

Figure VI.3–1—Determining the benefit–cost (B/C) ratio and the economic threshold (ET), based on grasshopper density per square yard and the cost of treatments.

Cost of Treatments

Hopper determines the costs in addition to the benefits for each treatment at varied densities of grasshoppers. Costs include materials and application expenses per acre, based on recent experience. The costs to apply a given treatment on the typical ranch in your area vary directly with number of acres in the ranch. If you expect the per-acre costs for the treatment(s) considered to differ from those specified in Hopper, you can change the costs to your current best estimate.

Hopper includes expected mortality (grasshopper kill) from each treatment. If dosage, treatment strategy, plant cover, or terrain is likely to change treatment effectiveness, the effective cost of treatment also will change. The benefits (damages abated) will not be as great from a treatment that is less effective (kills fewer grasshoppers) than a treatment that kills more grasshoppers.

The treatment costs reflected in Hopper are the total cost of treatments regardless of who pays. Through its Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ) staff, the U.S. Department of Agriculture pays treatment costs for controlling grasshoppers on Federal lands. The Department also pays a portion of the cost of treating intermingled and adjacent private lands. Some States also cost-share in the treatment programs. States may pay a portion of the cost of treating leased State land and a portion of the cost of treating private land. While the cost share may affect the out-of-pocket costs that a given rancher must pay, cost-sharing is not a part of the benefit and cost calculations of Hopper. Rather, in Hopper, benefits are directly compared to total costs, regardless of who pays.

Benefit–Cost Ratios

The ET is defined by a ratio of the per-acre benefits (B) and costs (C), or B/C (B ÷ C). When B/C = 1.0, the ET is reached (fig. VI.3–1). The B/C = 1.0 when the benefits line crosses the treatment cost line. At that grasshopper density, the ET is reached. At grasshopper densities less than where B/C = 1.0, damages (net return reductions) are occurring but are less than the cost of treatment. At densities greater than where B/C = 1.0, benefits (damages abated) are greater than treatment costs, and economic losses occur in the absence of treatments.

The B/C calculations in Hopper initially compare the costs of treatments to the benefits that result in the year of treatment. Many ranchers believe the benefits from effective treatments can last for several years. Consequently, with Hopper you can specify the expected duration (number of years) of control. If that number is >1, Hopper automatically takes it into account when calculating the B/C ratio.

Analysis with Hopper under varied conditions shows that the long-applied intervention level of 8 grasshoppers/yd^2 is not appropriate. Rather than a fixed ET, the ET in Hopper varies depending on rangeland productivity, the cost of replacing forage lost to grasshoppers, treatment costs, and treatment efficacy. Other physical, biological, and economic factors can affect the ET, too. By running Hopper, you can determine the grasshopper densities necessary to reach the ET on parcels like yours and the sensitivity of the ET to various conditions.

By using Hopper to define the ET, the ET is dynamic and may change from year to year at a given location. Further, the ET is different from location to location in any given year. The ET is determined by running Hopper for a typical ranch such as exists on a major range type. The typical ranch reflects the most common practices for the range type.

To characterize the ranches incorporated into Hopper, a ranch of a given size is described. Size is measured by the number of livestock as well as the amount of land available. The amount of grazing land is determined and for the deeded land, the amount that is owned and the amount that is leased are both specified. Public grazing land is divided by management agency between Federal and State. Grazing practices are also reflected in the economics component of Hopper. The use specifies the length of the grazing season, the time during which the different grazing land types are used, and the time when other sources of feed are fed. If some grazed forage is obtained from crop residue, that fact is reflected in Hopper. If harvested forage is fed, the time of its feeding and its source are also important.

The livestock management systems practiced and viable alternative livestock systems also are built into Hopper. Thus, the herd culling practices, typical calf crop, and disposition of steer and heifer calves must be accurately represented in Hopper.

As Hopper is used to evaluate a treatment decision and to determine the grasshopper density at which the ET is reached, several nontreatment management adjustments are automatically considered. The options available to each typical ranch are built into Hopper. Thus, if a grasshopper invasion occurs, the relevant changes in forage management and livestock herd management are considered simultaneously with the authorized treatment options. If leasing grazing land to replace grasshopper damaged grazing land is an option and leasing is less costly than any treatment, leasing other grazing land will occur before any treatment is applied. The availability of alternative forage and livestock management options affects the position of the benefits line and the grasshopper density at which the ET is reached.

Upon running Hopper, you can determine a separate benefits line for each approved treatment. Because treatments vary as to their cost and efficacy, Hopper calculates different ET's for each treatment. Of course, some treatments may not be possible because of environmental and biological circumstances present. In such cases, Hopper determines the ET only for the treatment options consistent with the conditions that prevail. Changes in treatment costs and efficacy also are important to the position of the B/C line. If treatments can be obtained at a reduced cost, the line shifts left and the ET is reached at lower grasshopper densities than for higher treatment costs.

Applying economic analysis to estimate the ET's for grasshopper treatments provides information-based decisions. Hopper defines typical ranches for important range ecosystems in which recurring grasshopper problems occur. We discuss these ranches in chapter VI.4.

References Cited

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