VII.12 Rangeland Environmental Amenities and Grasshopper Management Programs

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Range Ecosystems

Rangelands are increasingly recognized as important for their environmental and recreational amenities. Because they are managed much less intensively than many other types of agricultural lands, rangelands are seen to represent closer approximations to natural ecosystems. Rangelands are managed for a variety of outputs; in recent years, the contribution of natural rangeland systems to biological diversity has become increasingly recognized.

Rangelands provide two major values, those associated with use (use values) and those realized in the absence of direct use (existence and option or nonuse values). The major commercial use (use values) of rangelands is livestock grazing to produce food, fiber, and draft animals. Other, less significant, commercial uses such as wild game and bird hunting also are associated with rangeland habitats. In addition, rangelands are viewed as important contributors to watersheds: because rangelands usually have lower rates of soil erosion than cropland, they enhance water quality. Further, the natural system that exists on well-managed rangelands makes them increasingly recognized as places for nonconsumptive wildlife associated recreation.

Rangelands also produce intangible products (or nonuse values) that are the result of use. These products include natural beauty, open space, and the mere existence as a natural ecosystem (National Research Council 1994). Others emphasize biological diversity and the associated potential array of products and services as a distinct intangible product (West 1993). In contrast to use values, nonuse values occur almost entirely outside the market system. However, methods are evolving to quantify and assign monetary value to these existence values. As with use values, the costs and/or trade-offs associated with nonuse values can be compared to the estimated benefits (Bishop and Welsh 1992.)

Rangelands possess attributes that give them potential for biodiversity. Since they have not been "put to the plow," rangelands are attributed value as a natural system. Further, rangelands cover vast areas, often contiguously, and thereby possess the scale necessary for biodiversity of communities, ecosystems, and landscapes (West 1993).

The biodiversity of rangelands contributes to the intangible products mentioned in the National Research Council (1994) report. Recognition of the importance of biodiversity arises for several reasons: (1) morality, (2) esthetics, (3) economics, and (4) "biological services."

Increasingly land managers are learning of the effects of the impacts of management or lack of management on the ability for various species to survive. Some assert that mankind has a moral obligation to protect fellow creatures. Social awareness has also made managers and others aware of the need to protect spaces, natural systems, and historic sites. In addition to the value of present consumptive and nonconsumptive uses, rangelands also possess esthetic values, and other economic potentials exist. Potentially these natural systems include yet-to-be-identified goods that could be of value to people. Finally, ecosystems are important components of natural cycles affecting the gaseous composition of the atmosphere; genesis, fertility, and stability of soils; disposal of wastes; cycling of nutrients; and natural control of pathogenic and parasitic organisms (West 1993).

A healthy range is recognized as one in which the integrity of the soil and ecological processes of the rangeland ecosystem are sustained (National Research Council 1994). Whenever management intervenes in the natural processes, for whatever reason, the impact of those interventions on the rangeland's ability to sustain commercial as well as intangible products must be considered. Rangeland grasshoppers also can disrupt the natural ecosystem in two ways. First, grasshopper infestations can reach plague proportions. Serious and widespread outbreaks can lead to soil erosion and reductions in water quality and make it difficult—if not impossible—for the range to recover to its original state. Major infestations of grasshoppers destroy cover for ground-nesting birds and mammals and damage the habitat for other wildlife. The desire to protect the range ecosystem and adjacent croplands was an important part of the rationale for initiating the publicly assisted rangeland grasshopper control programs that exist today.

Second, grasshoppers are recognized as an integral and necessary part of a range ecosystem. Grasshoppers and other rangeland insects are an important part of the food

chain of some birds and mammals. Some species of grasshoppers are beneficial, feeding on plant forms that are not consumed by other users of the range. Because grasshoppers cut off vegetation as well as consume it, they create litter that becomes an important part of the nutrient cycle on rangelands. The strategy for managing rangeland grasshoppers has to be one of maintaining balance within range ecosystems.

The Grasshopper Integrated Pest Management (GHIPM) Project recognized the potential environmental costs associated with applying grasshopper management programs. One component addressed the safe use of grasshopper management programs around threatened and endangered plant species (Tepedino and Griswold 1993 unpubl.). Another chapter (III.6) in the environmental monitoring and evaluation section of the User Handbook evaluates the effects of grasshopper treatments on wildlife and aquatic species. The economics component of the Project developed procedures to make estimates of the environmental costs of control programs. This valuation recognizes, as the reader shall subsequently see, that fish and wildlife possess a value for recreation that considers both nonconsumptive (bird watching, photography, hiking) and consumptive (fishing, hunting) forms of wildlife-associated recreation.

Grasshopper program managers have been conscious of possible environmental side effects, undesired and beneficial, from these programs. Chemical applications may affect populations of some nontarget insect species as well as grasshoppers. Treatment program managers warn keepers of commercial insects so that those populations are protected. Managers of treatment programs take care to spray chemicals under conditions that minimize drift and to refrain from applying certain chemicals near water.

Evaluating Losses in Wildlife-Associated Recreation

Economists have made estimates of the value of some of the nontraditional outputs from rangelands (Bernardo et al. 1992, Kitts 1992, Loomis et al. 1989, Standiford and Howitt 1993, Young et al. 1987). Most of these studies have focused on consumptive and nonconsumptive forms of wildlife-associated recreation. However, a recent Colorado study estimated the value of open space. It found 80 percent of those spending summer vacations in the Steamboat Springs area indicated that ranch open space added significantly to their willingness to pay for summer visits. Willingness to pay for ranch open space averaged about $20 per day (Walsh et al. 1993).

Many of the biological–physical–management interactions associated with rangeland biodiversity are yet to be understood (West 1993). Consequently, very little has been done to evaluate the contributions of rangelands to biodiversity. Yet, under the Forest Management Act of 1976 and the Surface Mining Control and Reclamation Act of 1977, rangelands must be managed for biodiversity. Intangible values are reflected in policy directives even if quantification of those values has not occurred.

Reported here is an example of how rangeland environmental amenities can be evaluated. Chapter VI.3 of this Handbook discusses the method of estimating the economic loss to ranchers from an uncontrolled grasshopper outbreak. Applying chemical treatments reduces damages for the livestock grazer, and the damage reductions are the benefits of grasshopper controls. Pest managers also can estimate the economic loss if grasshopper control activities deplete wildlife populations. Figure VII.12–1 shows the flow of events.

If grasshopper management programs deplete wildlife populations, a reduction in the wildlife base will result in fewer people participating in wildlife-associated recreation. Because people place an economic value on recreation, less recreation means an economic loss. Investigators link the economic evaluation of wildlife depletion to grasshopper management and take the economic losses from wildlife-associated recreation as a measure of the portion of the environmental costs of the grasshopper treatment programs.

Calculations can start with the net economic values of wildlife-associated recreation estimated by Hay using willingness-to-pay techniques (1988a and b). Using the net economic value estimates for specific regions, it is possible to make estimates of the reduction in consumptive and nonconsumptive forms of wildlife-associated recreation resulting from a decrease in the wildlife resource base.

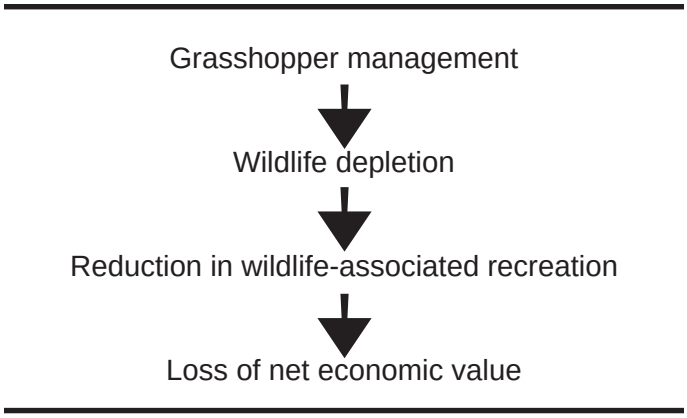

Figure VII.12–1—Sequence of events from grasshopper management to loss of value.

Analyzing the information reveals how participation in wildlife-associated recreation depends on demographic variables, price (cost of participating in recreation) and the wildlife resource base. Managers can use analyses for each type of wildlife-associated recreation (fishing, hunting, and nonconsumptive recreation) in the States for which control of rangeland grasshoppers is a problem.

The economic analysis involves the last two linkages of figure VII.12–1. Potential wildlife depletion results in a reduction in wildlife-associated recreation that, in turn, results in a net economic loss. This loss is a measure of a part of the potential environmental costs associated with grasshopper management programs.

Potential Environmental Costs

Table VII.12–1 shows Hay's net economic values for wildlife-associated recreation. These are the average net economic values for the eight States included in and surrounding the GHIPM demonstration sites. The net economic values are from surveys designed to determine how much participants value a day of recreation in these activities.

The next step to estimating the potential loss in wildlife-associated recreation resulting from grasshopper management programs is to look at the relationship between the wildlife resource base and the amount of participation in wildlife-associated recreation. The U.S. Fish and Wildlife Service conducts periodic surveys of fishing, hunting, and wildlife-associated recreation. The year for which the most recent survey data are available is 1985. Many factors determine the likelihood that an individual will participate in wildlife-associated recreation. For discussion in this chapter, we are primarily interested in one variable—the effects of the wildlife resource base on the probability of participation. If the wildlife resource base declines, we expect that the rate of participation in wildlife-associated recreation also will decline. Since grasshoppers and grasshopper treatments affect the habitat of wildlife, a measure of the wildlife resource base is habitat.

For hunting and nonconsumptive forms of wildlife-associated recreation, the amount of participation was sensitive to changes in the wildlife resource base. Fishing was not responsive to an estimate of changes in the fishing resource base. For hunting, a reduction of 1 percent in the range habitat of wildlife (for example a 1-percent reduction in the capacity of a range to support game wildlife) results in a 3.2-percent reduction in hunting participation. Similarly, a 1-percent reduction in the rangeland wildlife base results in a 2.9-percent reduction in participation in nonconsumptive forms of wildlife recreation.

Table VII.12–1—Net economic values per day of wildlife-associated recreation, by recreational activity in the eight-State region[1]

Activity	Net economic value (dollars/day)
Hunting	
Deer	$35
Elk	$36
Waterfowl	$20
Fishing	$11
Nonconsumptive	$22

[1]Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Utah, Wyoming.
Source: Hay (1988 a and b).

The statistical equations give estimates of the number of participants in each wildlife-associated recreation activity. In this chapter, we focus on how wildlife-associated recreation changes in response to changes in the resource base. Table VII.12–2 shows the base level estimate of the number of hunters in the eight-State region, their expenditures, participation days, and the net economic value from hunting in the region.

The table also shows the potential impact of a 1-percent decline in the game wildlife resource base and the associated economic impact. We can interpret the analysis two ways. A 1-percent increase in the wildlife resource base would result in an increase of the same magnitude in participation, expenditures, hunting days, and net economic value, as would a 1-percent decrease. Thus, if the use of a grasshopper treatment program reduces the wildlife resource base, we can measure the cost (loss in net economic value). Conversely, if grasshoppers destroy the habitat for wildlife and a reduction in game wildlife occurs, we also can estimate the potential losses from less hunting on grasshopper-damaged rangeland.

Using the estimated equations for nonconsumptive forms of wildlife recreation, table VII.12–3 shows the base economic activity and potential losses if a grasshopper invasion reduces the wildlife resource base. As with hunting, nonconsumptive wildlife-associated recreation also may suffer if an uncontrolled grasshopper outbreak reduces the wildlife resource base.

Potential Recreation Losses

The economic losses associated with changes in the wildlife resource base are only potential losses. The environmental monitoring component of the GHIPM Project has not found adverse effects on wildlife resulting from use of grasshopper control programs. Approved treatment options are the result of careful evaluation and selection to determine materials and methods which minimize the threat to the environment. When there are grasshopper treatments, these precautions to minimize the environmental damage apparently are successful. So long as the first linkage in figure VII.12–1 remains zero, meaning grasshopper treatments do not result in wildlife depletion, the economic losses from reductions in wildlife-associated recreation are also zero. However, should damages to the wildlife resource base occur, the changes in net economic value due to wildlife-associated recreation can be estimated by applying this procedure.

Conclusions

With increased understanding of the linkages and relationships present in rangeland ecosystems, it will be possible to quantify more of the identified benefits from rangeland biodiversity and other intangible values. Until that time, rangeland management and actions taken to control rangeland pests must proceed with the best available understanding of the results from those management interventions.

Table VII.12–2—Hunting: Effect of reduced wildlife resources on the number of participants and trip-related expenditures and on participation-days and net economic value

Wildlife resource level	Number of participants	Trip-related expenditures	Participation-days	Net economic value
	Thousands	*$ million*	*Thousands*	*$ million*
Base level	790,000	$191.2	11,847	$355.4
1% decline	–25	–6.1	–371	–11.1

Table VII.12–3—Nonconsumptive: Effect of reduced wildlife resources on number of participants and trip-related expenditures and on participation-days and net economic value

Wildlife resource level	Number of participants	Trip-related expenditures	Participation-days	Net economic value
	Thousands	*$ million*	*Thousands*	*$ million*
Base level	1,501	$253.7	15,009	$330.2
1% decline	–43	–7.3	–429	–9.4

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