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Economic impact of leafy spurge in Montana, South Dakota, and Wyoming

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Agricultural Economics Report No. 275 November 1991

ECONOMIC IMPACT OF LEAFY SPURGE IN MONTANA, SOUTH DAKOTA, AND WYOMING

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ACKNOWLEDGMENTS

Research efforts directed at determining the economic impacts of leafy spurge in the upper Midwest have been ongoing at North Dakota State University for over 3 years. Several colleagues at North Dakota State University have contributed greatly to this effort. The authors thank Rod Lym and Calvin Messersmith (Department of Crop and Weed Sciences), Jay Leitch and Nancy Wallace (Department of Agricultural Economics), Don Kirby (Department of Animal and Range Sciences), Russ Lorenz (Agricultural Experiment Station), and the many others who have contributed to the research effort.

Several people were instrumental in providing data and information crucial to this study. Special thanks are extended to:
Sandy Brooks (Bureau of Land Management-Montana)
Don Glenn (Bureau of Land Management-Wyoming)
Cecile Gray (U.S. Forest Service-Washington, D.C.)
George Wiggins (U.S. Forest Service-Wyoming)
Leslie Saisbury (Montana Department of State Lands)
Ines Valentine (Wyoming State Land Office)
Todd Schuetzle and Mike Cornelison (South Dakota Department of School and Public Lands)
Barbara Mullin (Montana Department of Agriculture)
Dennis Clarke (South Dakota Department of Agriculture)
George Hittle (Wyoming Department of Agriculture)
JoDee Hutchason (Department of Plant, Soil, and Insect Sciences-University of Wyoming)
Doug Harrison and Dennis Phillipe (Montana Soil Conservation Service)
Evertt Bainter (Wyoming Soil Conservation Service)
David Schmidt (South Dakota Soil Conservation Service)
Martin Beutler and Larry Janssen (Department of Economics-SDSU)
Robert Carver (Department of Agricultural Economics-University of Wyoming), and
Fred Kuchler, Roger Hexem, and Patrick Canning (Economic Research Service-USDA).

Thanks are given to Jean Ah Puck for document preparation, Charlene Lucken for editorial assistance, Sharon Hilber for graphic assistance, and to our colleagues who reviewed this manuscript.

Financial support was provided by the Animal and Plant Health Inspection Service through the Cooperative State Research Service of the U.S. Department of Agriculture. We express our appreciation to these organizations for their support.

The authors assume responsibility for any errors of omission, logic, or otherwise.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

List of Figures

LIST OF APPENDIX TABLES

List of Appendix Figures

HIGHLIGHTS

Leafy spurge is an exotic, noxious perennial weed that has become widely established in many midwestern states. Leafy spurge exhibits exceptional ability to spread and thrive in a wide variety of habitats. This ability, combined with its hardy, control-resistant nature, has made it a serious problem for farmers and ranchers. Leafy spurge currently infests about 1.5 million acres of rangeland in Montana, North Dakota, South Dakota, and Wyoming. The recognition of this plant's persistent and aggressive nature, combined with current infestation rates in many areas of the Upper Great Plains, has prompted concern over the impact this weed has on area economies and the amount of resources that should be devoted to developing viable leafy spurge control technologies.

A carrying capacity reduction model was used to estimate the reduction in grazing capacity from leafy spurge infestations. Montana had 431,000 acres of leafy spurge infestations on grazing lands in 1990, which reduced grazing capacity by 159,000 animal unit months (AUMs) or enough to support a cow-calf herd of 17,000. South Dakota had 80,000 acres of leafy spurge infestations on grazing lands in 1990, which reduced grazing capacity by 96,000 AUMs or enough to support a cow-calf herd of 10,400. Wyoming had 61,000 acres of leafy spurge infestations on grazing lands in 1990, which reduced grazing capacity by 25,000 AUMs or enough to support a cow-calf herd of 2,700.

The reduced grazing capacity represented $2.2 million, $1.4 million, and $221,000 in foregone income to ranchers and landowners in Montana, South Dakota, and Wyoming, respectively. Also, ranchers did not spend another $3.5 million, $2.4 million, and $557,000 on input costs, which represents lost revenue to related businesses.

An input-output model was used to estimate the secondary impacts to the states' economies. Total direct impacts of $5.7 million, $3.8 million, and $778,000 generated $13 million, $8.8 million, and $1.8 million, respectively, in secondary lost income and reduced business activity. Total impacts included a loss of 187, 131, and 22 jobs in Montana, South Dakota, and Wyoming, respectively. Direct and secondary impacts to the states' economies approached $34 million in 1990. If leafy spurge is allowed to spread unrestricted, potential impacts in Montana, South Dakota, and Wyoming could reach $46 million annually by 1995.

Leafy spurge has serious economic impacts for ranchers, landowners, and area economies. Montana, South Dakota, and Wyoming in 1990 lost about $120 in foregone business activity and reduced income per lost AUM. The potential returns from leafy spurge control could be substantial, and continuing efforts to develop economical control methods for leafy spurge remain justified.

Economic Impact of Leafy Spurge in Montana, South Dakota, and Wyoming

Dean A. Bangsund and F. Larry Leistritz[1]

INTRODUCTION

Leafy spurge (Euphorbia esula) is an exotic, noxious perennial weed that has become widely distributed in the northern Great Plains. The plant is found primarily in nontilled agricultural land (pasture, rangeland, hayland, and idle cropland) and in road ditches, around lakes, and in parks. Because leafy spurge exhibits exceptional ability to spread and thrive in a variety of habitats, is hardy, and resists control, it has become a serious problem for farmers and ranchers.

Leafy spurge was established primarily in Minnesota, North Dakota, Montana, and several eastern states in 1933; since then it has continued to spread to several midwestern states (Hanson and Rudd 1933). Heavy infestations of leafy spurge can be found in North Dakota, South Dakota, Montana, Minnesota, Nebraska, Colorado, Idaho, and Wyoming. The prevalence of leafy spurge expansion can be realized by examining the number of acres affected in North Dakota during the past thirty years. North Dakota had an estimated 200,000 acres of leafy spurge in 1962, 423,000 acres in 1973, 862,000 acres in 1982, and approximately 1.1 million acres in 1990 (North Dakota Department of Agriculture 1991).

Numerous studies have been conducted to examine the effectiveness of chemical treatments in restricting the spread of leafy spurge (Messersmith 1989). Herbicide treatments vary in effectiveness depending on the chemical agent, application rate, timing of application, and age and size of the leafy spurge plant. The effectiveness of chemical treatments in controlling leafy spurge growth, cost of chemical applications, and value of rangeland production indicate that most chemical treatments are not economical (Thompson et al. 1990; Messersmith 1989).

Recent research efforts to control leafy spurge have focused on developing, expanding, and improving biological agents (insects and plant diseases), due in part to growing environmental concern over chemical use and the apparent ineffectiveness of chemical treatments to provide economical long-term control. Leafy spurge has been considered a potentially viable candidate for biological control since natural forces appear to hold the plant in check in its native European habitat (Carlson and Littlefield 1983). Although considerable resources have been devoted to developing integrated leafy spurge control mechanisms (use and interaction of biological, cultural,

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and chemical control agents), little effort has been directed at evaluating the economic impacts of leafy spurge.

Thompson (1990) estimated the economic impacts of leafy spurge infestations in North Dakota. The economic impacts were based on estimating the loss of AUMs of grazing attributable to leafy spurge infestations using a carrying capacity reduction model. Thompson (1990) estimated that 577,000 AUMs, valued at $8.6 million, were lost because of leafy spurge infestations on grazing lands in North Dakota. An additional $14.4 million was not spent by ranchers and producers on input costs, which represented reduced revenue for businesses. Thompson (1990) estimated total impacts (direct and secondary) from leafy spurge in North Dakota to be about $75 million annually.

Several factors have highlighted the concern over determining the economic impact of leafy spurge on farmers and ranchers and on area economies. The cost and ineffectiveness of chemical treatments and the growing public pressure to restrict chemical use in agriculture may force many producers to re-evaluate chemical control practices. Without chemical use to control leafy spurge, the weed may spread unchecked in many areas. Since biological control may be several years away from being an effective control measure, concern over the weed's continued spread has increased.

The rate of infestation has reached serious levels in many areas of the Upper Great Plains, raising concerns from producers and policymakers over the amount of resources that should be used to develop viable leafy spurge control technologies. Economic information on leafy spurge infestations is required to understand the importance of leafy spurge control and to allocate resources to develop new control technologies.

OBJECTIVES

The purpose of this report is to estimate the economic impacts (direct and secondary effects) of leafy spurge infestations to landowners and ranchers and to the state economies of Montana, South Dakota, and Wyoming. Specific objectives include:

1) estimating the economic impacts of leafy spurge infestations on grazing lands to landowners and ranchers in Montana, South Dakota, and Wyoming,

2) estimating the direct and secondary economic impacts of leafy spurge infestations on grazing lands to the state economies of Montana, South Dakota, and Wyoming, and

3) estimating the economic impacts of leafy spurge infestations on the regional economy.

PROCEDURES

The methods and analysis used in this report generally parallel those used by Thompson et al. (1990). The first step in determining the impact from leafy spurge infestations was to estimate the lost carrying capacity in animal unit months (AUMs). The lost AUMs were assigned a value, estimated either from using grazing land rents or a cow-calf budget analysis. After the lost AUMs were assigned a value, the losses were summed by area and applied to an input-output model to estimate the secondary effects on the states' economies. Additional cow-calf budget analyses estimated the foregone production outlays caused by the lost AUMs. The direct and secondary effects were summed by state and region.

Data Sources

A vast amount of effort was extended to assure that the data and information used in this report were consistent among states and represented the most recent information available. The following sections briefly list the sources of data and information used in this report. All data gathered for this report were detailed to the county level unless otherwise noted.

Grazing Acres

The 1987 Census of Agriculture was used to estimate acres of private pasture and rangeland. However, unlike most states, Montana, South Dakota, and Wyoming have many acres of federally owned grazing lands and considerable state-owned grazing lands. The *Census of Agriculture* does not include grazing lands that are leased on an AUM basis. Thus, state and federal grazing land leased on an AUM basis was determined by contacting the respective agencies. Land on Indian reservations used for grazing and land under exclusive use by grazing associations are included in the *Census of Agriculture* estimates.

Leafy Spurge Infestation Rates

The state agencies responsible for inventorying weed populations were contacted for estimates of leafy spurge acreage on grazing lands. However, before acreage and infestation rates are discussed, the difference between leafy spurge acreage and leafy spurge infestation rates needs to be clarified.

The amount (acres reported) of leafy spurge should not be confused with leafy spurge infestation rates. Leafy spurge acreage, as reported by weed inspectors, represented acres of

grazing lands that contained some leafy spurge (the actual density or surface amount varied). Thus, an acre of leafy spurge could be an entire acre of solid leafy spurge or it could be an acre of grazing land with an intermittent or sparse stand of leafy spurge spread out in different parts of the grazing acre. Although the two illustrations (from a range management perspective) actually represent different amounts of leafy spurge, each would be reported as one acre of leafy spurge.

Leafy spurge infestation rates, as used in this report, differed from leafy spurge acreage. Infestation rates refer to the percentage of total grazing acres containing some leafy spurge. For example, if a county has reported 1,000 acres of leafy spurge and has 10,000 acres of grazing lands, the leafy spurge infestation rate would be 10 percent. Thus, a county having an infestation rate of 10 percent may actually have fewer acres of leafy spurge than a county having an infestation rate of 8 percent.

Montana has over four times as much leafy spurge acreage as either South Dakota or Wyoming. Leafy spurge acres were compared with the number of grazing acres to indicate the relative scope of the problem. The level of leafy spurge infestation, as a percentage of grazing acres, was estimated for each county in the three states by dividing leafy spurge acres by total grazing acres (Appendix Tables A1 and A2). Even though most counties in Montana, Wyoming, and South Dakota had low infestation rates (i.e., acres of leafy spurge compared to acres of grazing lands), substantial acres of leafy spurge have been reported (Figures 1, 2, and 3). Leafy spurge appears to be concentrated in central and eastern Montana, northeastern Wyoming, and eastern South Dakota.

Grazing Land Rental Rates

Private grazing land cash rent data were obtained from the United States Department of Agriculture-Economic Research Service's (USDA-ERS) unpublished Agricultural Stabilization and Conservation Service (ASCS) survey data for 1982 through 1990. The unpublished data were from an annual land value survey, conducted by USDA-ERS, of county ASCS offices.

Grazing Land Carrying Capacity

Estimates of private pasture and rangeland carrying capacity (AUMs/acre) were obtained from the USDA-Soil Conservation Service (USDA-SCS) in each state. Estimates of the carrying capacity (AUMs/acre) for state and federal grazing lands were obtained from the respective agencies.

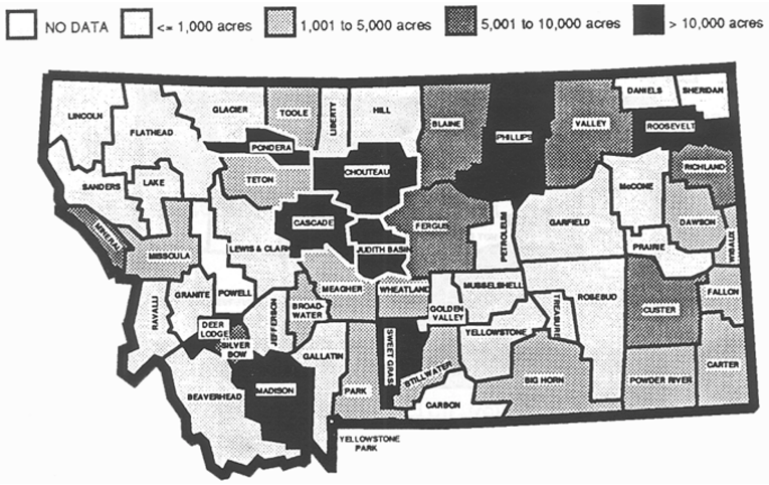

Figure 1. Distribution of Leafy Spurge in Montana Grazing Lands, 1990

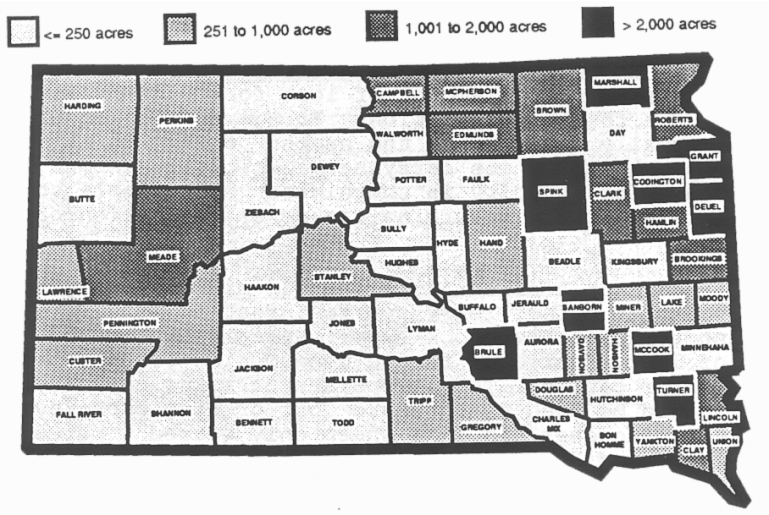

Figure 2. Distribution of Leafy Spurge in South Dakota Grazing Lands, 1990

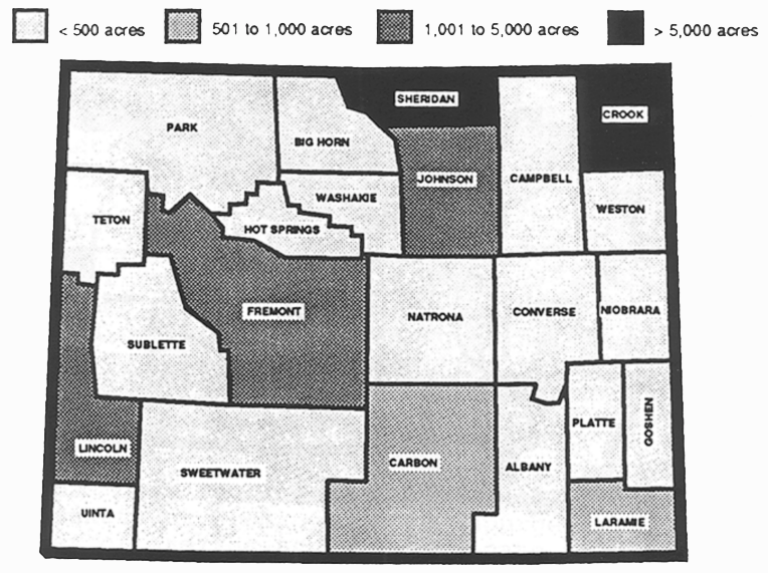

Figure 3. Distribution of Leafy Spurge in Wyoming Grazing Lands, 1990

Effect of Leafy Spurge on Carrying Capacity

A critical step in estimating the economic impact of any weed is to estimate the amount of lost forage or crop yield reduction due to the infestation. Forage production of grazing lands is usually measured by the number of animals the land can safely support (i.e., its carrying capacity or maximum stocking rate). Carrying capacity is the highest sustainable stocking rate possible without incurring damage to vegetation or related resources.

An important consideration in determining lost grazing capacity is the effect leafy spurge infestations have on different types of livestock (i.e., sheep and cattle). The impact of leafy spurge on forage consumption for sheep is less than that for cattle. Thus, separate carrying capacity reduction models should be used to estimate lost grazing capacity for sheep and cattle. However, in 1990 sheep only grazed 6 percent, 5.2 percent, and 7.8 percent of the available AUMs in Montana, South Dakota, and Wyoming, respectively

An average of 1989 and 1990 Agricultural Statistics Service's inventory of stock sheep and lambs for each state was used to estimate the amount of sheep grazing, assuming five grazing sheep per AUM and seven months grazing period. Since sheep grazed only about 6.3 percent of the available

AUMs in Montana, South Dakota, and Wyoming, all rangeland and pasture affected by leafy spurge infestations in the three states were assumed to be grazed by cattle.

A Carrying Capacity Reduction Model (CCRM), developed by Thompson (1990), was used to estimate the lost forage from leafy spurge infestations. The relationship between lost grazing capacity and amount of leafy spurge infestation is approximated by the linear function:

RCC = CC * [1 - (1.25 * PI/100)]

where RCC = reduced carrying capacity (AUMs/acre)
CC = normal carrying capacity (AUMs/acre)
PI = level of infestation expressed as a percent of land area covered by leafy spurge (%)

A 40 percent leafy spurge infestation would reduce carrying capacity by 50 percent from a practical range management position (Figure 4).

The CCRM estimates the potential AUM reduction for cattle only. Leafy spurge reduces carrying capacity for cattle through two means: (1) inhibiting normal herbage production from direct competition of the spurge plant and (2) reducing available herbage since cattle totally or partially avoid range sites infested with leafy spurge (this effect is accentuated during spring grazing).

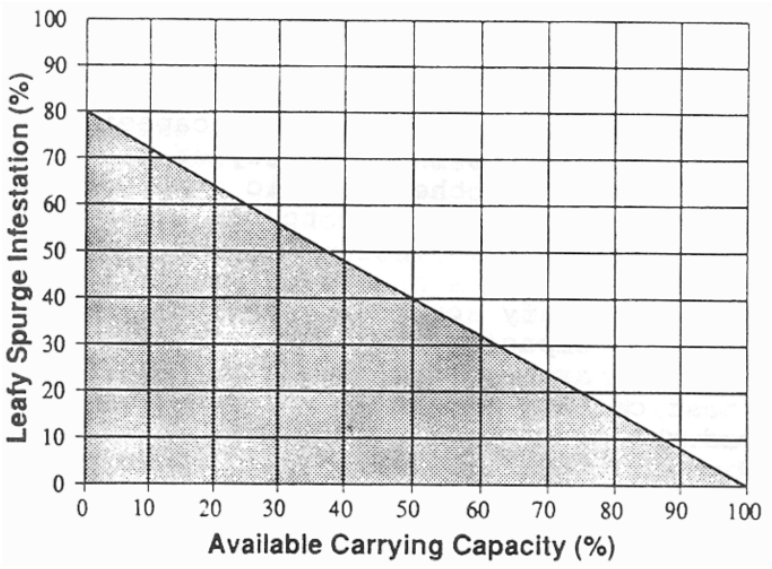

Figure 4. Reduced Carrying Capacity Associated With Various Levels of Leafy Spurge Infestation

Source: Thompson 1990.

Data and Method Shortcomings

Several shortcomings with the data and methods used in this analysis are apparent. These "weak links" include the estimates of leafy spurge acreage, information on grazing acres and carrying capacities, information on localized differences in cash rents and grazing land lease rates, and adjustments of the CCRM to reflect various grazing conditions and practices.

Several concerns exist with the data on leafy spurge acreage. The extent of leafy spurge acres found in grazing land, cropland, non-agricultural land, and public land needs to be identified. A measure of the extent of a leafy spurge infestation is needed, such as the difference between heavy (e.g., solid leafy spurge), moderate (e.g., maybe 40 to 80 percent cover), or mild (e.g., 20 or less percent cover) infestations.

Much information is required to accurately estimate the number of AUMs produced. Information on current conditions of rangeland, regional differences in grazing practices, and localized estimates of carrying capacities would be helpful in assessing the number of AUMs available to ranchers and producers. Information of this type is not readily available in sufficient detail.

Thompson (1990) developed a model to estimate the grazing reduction from leafy spurge under conditions found in North Dakota. The model may not be applicable to grazing conditions in other states or applicable to different conditions within North Dakota. Little empirical information has been compiled to estimate the relationship between carrying capacity reductions and leafy spurge infestations in a variety of grazing conditions and practices. Estimates of the economic impacts of leafy spurge on grazing lands is highly sensitive to the estimated reductions in available AUMs.

The existence of leafy spurge has influenced grazing rents, land values, carrying capacities, range management practices, and ultimately, local and area economies. The degree of this influence, in most cases, is unknown. The complexities of the factors involved and lack of information to quantify those factors forced us to conduct our analyses using a counter-factual baseline scenario. This "before-the-fact" assumption that leafy spurge has not already influenced the data used in the analysis (i.e., cash rents, carrying capacities, AUM values, grazing practices) may or may not affect the results.

If the "weak links" in the data and methods described previously could be strengthened, estimates of the economic impact of leafy spurge would also be improved. However, the

costs of strengthening the "weak links" need to be weighed against the benefits of refinements in the economic impact estimates.

RESULTS

The following section is divided into four parts: (1) grazing capacity (grazing acres and AUMs per state), (2) AUMs lost because of leafy spurge infestations, (3) losses incurred by landowners and ranchers from leafy spurge infestations on grazing lands, and (4) the direct and secondary impacts of leafy spurge infestations on state and regional economies.

Grazing Capacity

Several steps were used to calculate total grazing capacity (1) private and public grazing acres were compiled, (2) carrying capacities of private grazing lands were estimated, and (3) the amount of private AUMs was estimated and combined with public AUMs to determine total available AUMs for each state.

Pasture and Rangeland Acres

The amount of private, state, and federally owned grazing lands by county was estimated for Montana, South Dakota, and Wyoming using data from the 1987 Census of Agriculture, state land departments, the United States Bureau of Land Management (USBLM), and the United States Forest Service (USFS) (Appendix Tables B1, B2, and B3). The United States Bureau of the Census estimates of pasture and rangeland include land on Indian reservations and tribal trust lands used for grazing and land under exclusive use by grazing associations. Also, all state and federally owned grazing land leased on a per acre basis was included in the *Census of Agriculture* estimates. South Dakota state grazing lands are leased on a per acre basis (Janssen et al. 1990). Those acres were subtracted from *Census of Agriculture* estimates to determine private pasture and rangeland acres. Montana and Wyoming state land departments, USBLM, and USFS lease grazing acres on an AUM basis and thus represent additional grazing acres not included in the *Census of Agriculture* estimates. Montana, South Dakota, and Wyoming have approximately 134 million grazing acres, with Wyoming and Montana each having about 54 million grazing acres (Table 1).

TABLE 1. PRIVATE, STATE, AND FEDERAL GRAZING LANDS IN MONTANA, SOUTH DAKOTA, AND WYOMING, 1990

State	Grazing Acres by Ownership			
	Private[a]	State[b]	Federal[c]	Totals
Montana	39,970,917	4,153,972	10,276,495	54,401,385
South Dakota	22,023,115	795,889	2,156,914	24,975,918
Wyoming	29,013,540	3,638,410	22,098,100	54,750,050
TOTALS	91,007,572	8,588,271	34,531,509	134,127,353

[a]Estimates of private grazing acres were obtained from the U.S. Bureau of the Census, 1987, 1982, & 1978 Census of Agriculture.
[b]Only grazing acres reported by state land departments were included. Grazing acres leased by other state departments or agencies were not included.
[c]Only grazing acres reported by the Bureau of Land Management and the United States Forest Service were included.

Carrying Capacity

Carrying capacity is generally determined by the number of animal unit months (AUMs) a tract of land can provide. An AUM is an average figure of the amount of forage needed to feed one animal unit (AU) for one month. An AU is typically considered a mature cow weighing approximately 1,000 pounds or an equivalent grazing animal(s) based on an average feed consumption of 26 pounds of dry matter per day (Shaver 1977).

The USDA-SCS classifies land into major land resource areas (e.g., 15" to 19" foothills and mountains west, 10" to 14" eastern sedimentary plains) for all states based on precipitation and general growing conditions. Each major land resource area is broken into specific range sites. The USDA-SCS rates the carrying capacity of a range site for each of four range condition classes--excellent, good, fair, and poor. Each class measures the "state of health" of the range vegetation and is based on the amount of climax vegetation present. Climax vegetation is the highest ecological development of a plant community capable of perpetuation under the prevailing climate and soil conditions (Shaver 1977). Excellent, good, fair, and poor range conditions contain greater than 75, 51 to 75, 26 to 50, and less than 25 percent of current climax vegetation, respectively. The amount and quality of forage production decreases considerably as range condition decreases from excellent to poor.

Carrying capacities were estimated to determine the number of AUMs produced on private pasture and rangeland. The first step in determining county-level carrying capacities was to estimate the carrying capacity for private rangeland. Pasture carrying capacities were estimated based on an assumption that pasture is 1.5 times as productive as native rangeland.

Carrying capacities for South Dakota pasture and rangeland were obtained from the state SCS office. The rates were based on high condition upland range sites for areas of the state containing similar growing conditions (Figure 5). Carrying capacity of native rangeland and pasture in South Dakota is highest in the southeast corner and decreases with range sites in the west.

Carrying capacities for Wyoming and Montana rangeland were calculated using information received from the Wyoming and Montana state SCS offices. The number of acres of various range sites in each county and technical guides for each range site were used to calculate a county-average carrying capacity. County-average carrying capacities for rangeland were weighted by the number of acres in each range site (distinguished by the number of acres in each range condition for each range site). The weighted average carrying capacities should typify general carrying capacities within each county. However, carrying capacities for pasture and rangeland within Wyoming counties vary greatly due to the number of range sites, vegetation zones, and precipitation zones within each county (Figure 6).

Information needed to estimate an average rangeland carrying capacity for some counties in Montana was not available. Carrying capacities for the counties with missing information were estimated by calculating an average for each agricultural statistics district. The carrying capacity for each agricultural statistics district was calculated by pooling the stocking information from counties for which carrying capacities had been estimated (i.e., total acres and AUMs for the counties were summed to determine the district average which was then assigned to the counties with missing information).

Information was not available for any county in Montana's southwest agricultural statistics district; however, since the southwest agricultural statistics district is within the same major land resource area as the northwest agricultural statistics district, counties in the southwest district were assigned the average carrying capacity from the northwest district. The general carrying capacity of native rangeland and pasture in Montana is highest in the central and western regions of the state and decreases in the eastern regions (Figure 7).

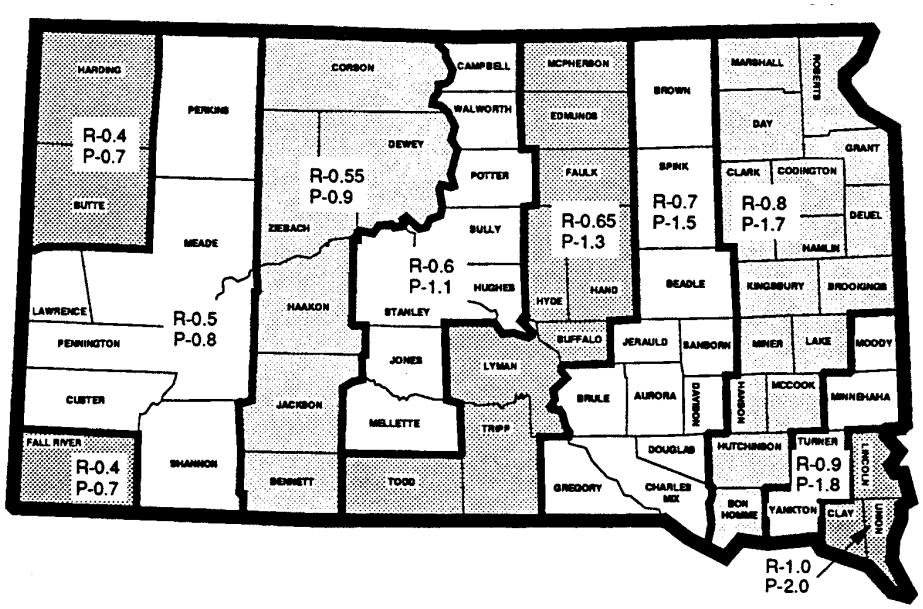

Figure 5. Estimated Carrying Capacities (AUMs/Acre) for Pasture and Rangeland in South Dakota, 1990

Source: Soil Conservation Service state office, Huron, South Dakota.

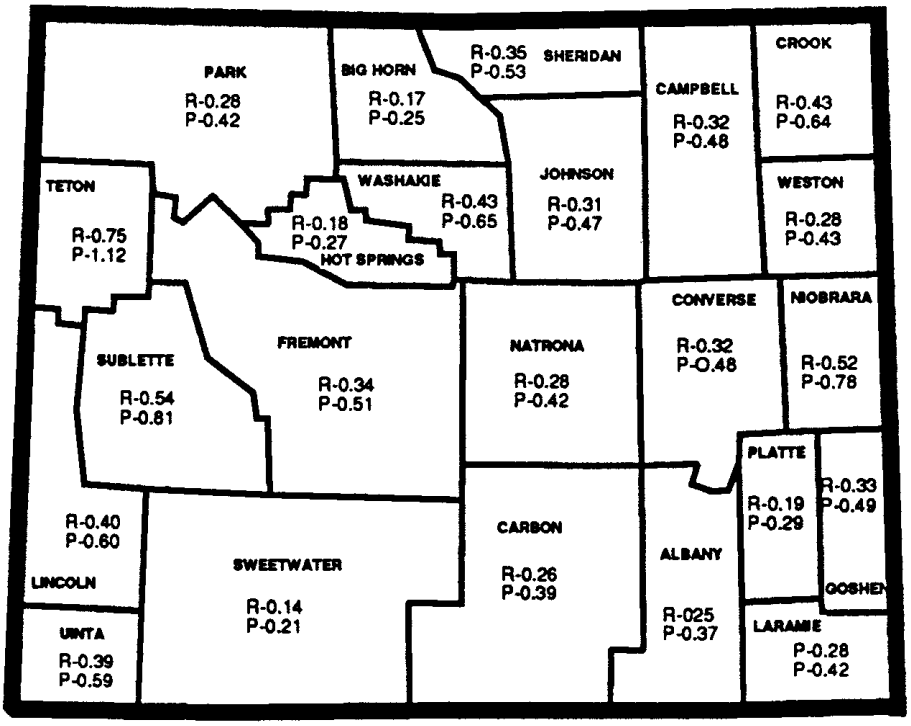

Figure 6. Estimated Carrying Capacities (AUMs/Acre) for Pasture and Rangeland in Wyoming, 1990

Source: Soil Conservation Service state office, Casper, Wyoming.

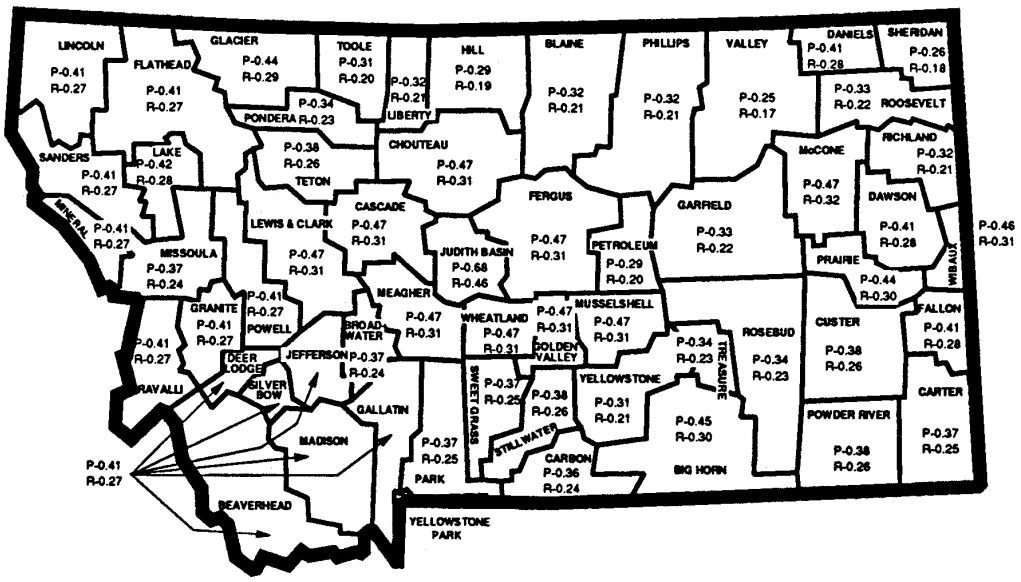

Figure 7. Estimated Carrying Capacities (AUMS/Acre) for Pasture and Rangeland in Montana, 1990

Source: Soil Conservation Service state office, Bozeman, Montana.

Production of Animal Unit Months

The AUMs produced by state and federal grazing lands are available; however, AUMs produced on private land had to be estimated. Private grazing land includes both pasture and rangeland; however, since pasture and rangeland typically have different carrying capacities, an average carrying capacity for private grazing land was determined from estimates of pasture and rangeland carrying capacities. The 1987 Census of Agriculture did not provide separate acreage estimates for pasture and rangeland; however, separate estimates for pasture and rangeland were available from the USDA-SCS.

The USDA-SCS conducted a *National Resources Inventory* (NRI) in 1987 that included separate estimates for pasture and rangeland acres by county for all nonfederal land; however, the 1987 NRI data were not statistically valid at the county level. Thus, the 1987 NRI information was summed by agricultural statistics districts to estimate a ratio of pasture-to-rangeland(Figures 8, 9, and 10). The ratio of pasture-to-rangeland for each district was applied to county carrying capacity estimates to obtain a weighted average

carrying capacity that accounts for productivity differences between pasture and rangeland (Figures 11, 12, and 13). State grazing lands were assumed to be rangeland and were subtracted from the 1987 NRI data to reflect private grazing conditions more accurately. Private production of AUMs was estimated by multiplying private pasture and rangeland acres by the weighted average carrying capacity. Private AUMs were combined with state and federal AUMs to estimate total AUMs per county for Montana, South Dakota, and Wyoming (Appendix Tables C1, C2, and C3). Assuming no leafy spurge infestation and assuming private rangeland and pasture were grazed at the highest sustainable stocking rates, Montana, South Dakota, and Wyoming produced 14.2 million, 14.4 million, and 12.7 million AUMs in 1990, respectively (Table 2).

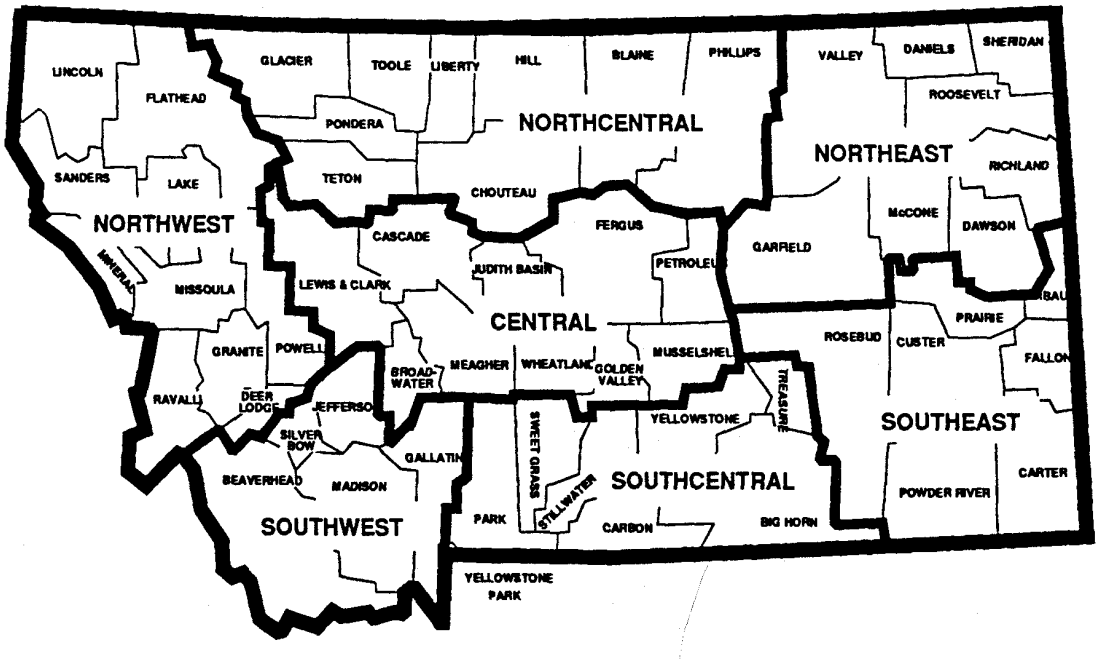

Figure 8. Montana Agricultural Statistics Districts

Source: Montana Agricultural Statistics Service, Helena, Montana.

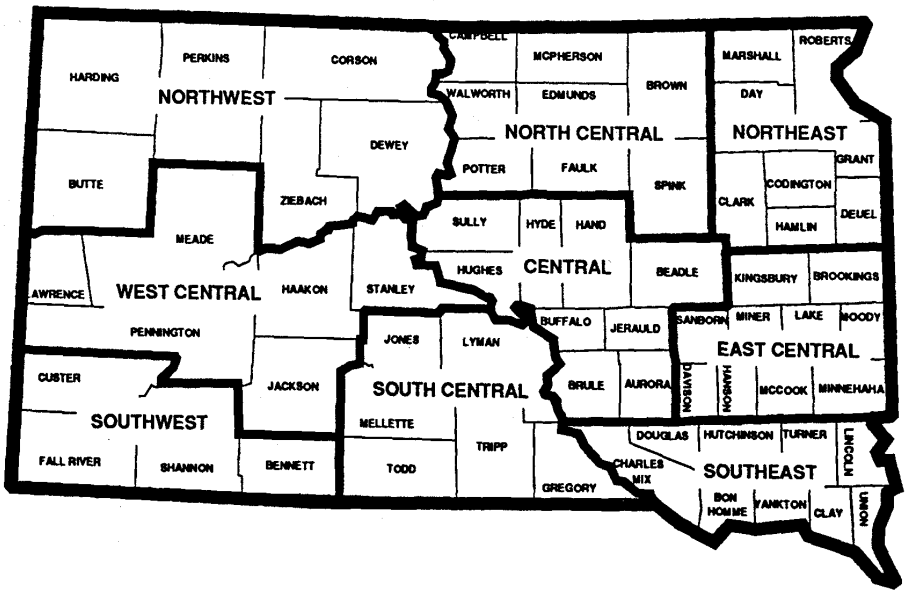

Figure 9. South Dakota Agricultural Statistics Districts

Source: South Dakota Agricultural Statistics Service, Sioux Falls, South Dakota.

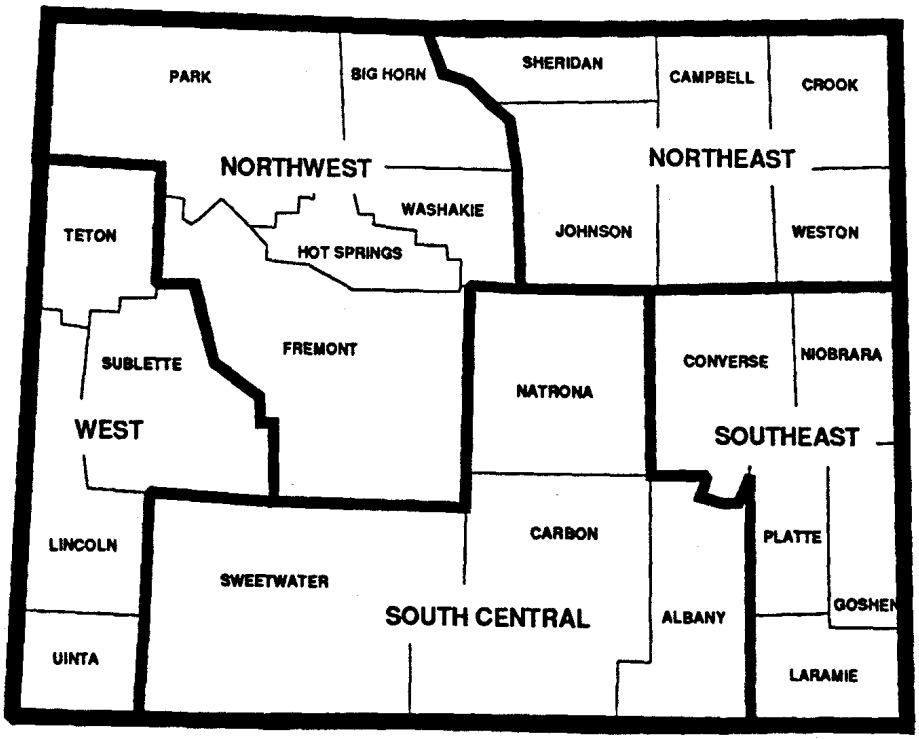

Figure 10. Wyoming Agricultural Statistics Districts

Source: Wyoming Agricultural Statistics Service, Cheyenne, Wyoming.

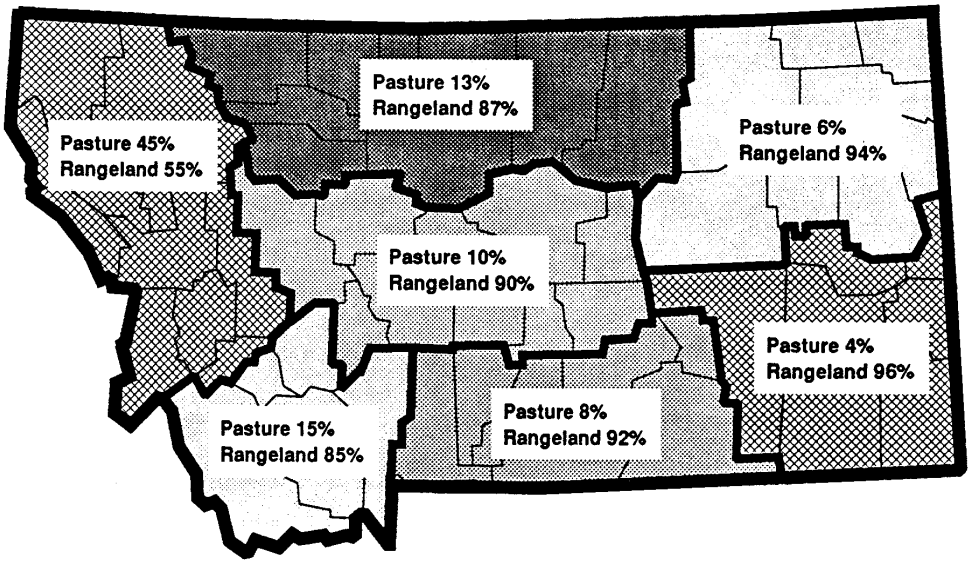

Figure 11. Percent Pasture and Rangeland Distribution of Montana Grazing Lands by Agricultural Statistics Districts, 1987

Source: *1987 National Resources Inventory*, Soil Conservation Service, Bozeman, Montana.

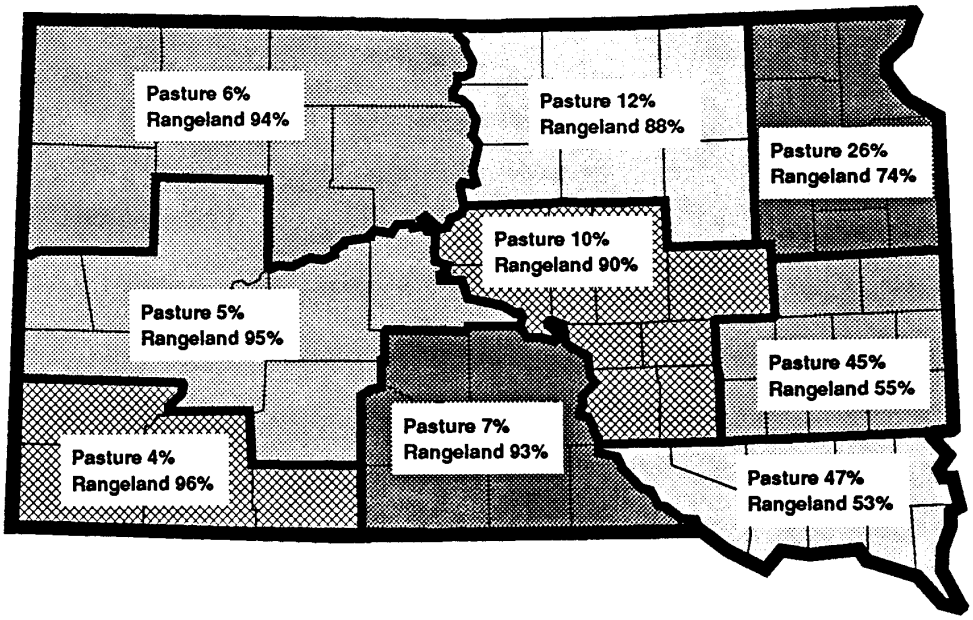

Figure 12. Percent Pasture and Rangeland Distribution of South Dakota Grazing Lands by Agricultural Statistics Districts, 1987

Source: *1987 National Resources Inventory*, Soil Conservation Service, Huron, South Dakota.

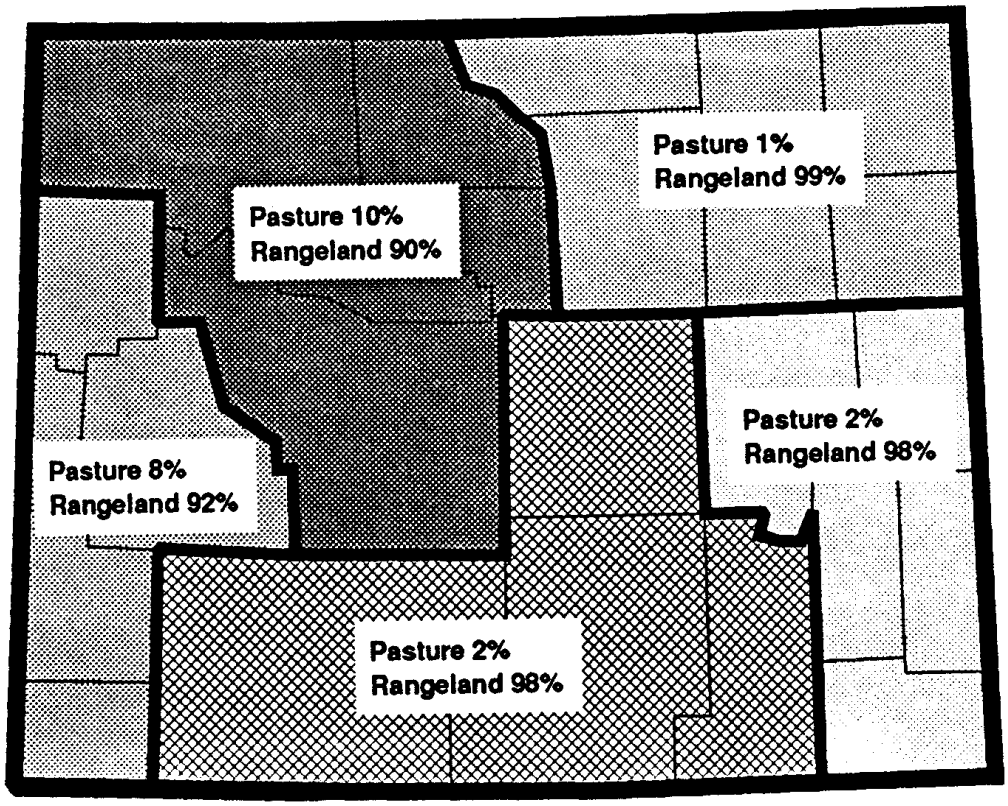

Figure 13. Percent Pasture and Rangeland Distribution of Wyoming Grazing Lands by Agricultural Statistics Districts, 1987

Source: *1987 National Resources Inventory*, Soil Conservation Service, Casper, Wyoming.

TABLE 2. PRODUCTION OF PRIVATE, STATE, AND FEDERAL AUMS IN MONTANA, SOUTH DAKOTA, AND WYOMING, 1990[a]

	AUMs by Land Ownership			
State	Private	State[b]	Federal	Totals[c]
Montana	10,853,878	1,022,263	2,276,834	14,152,974
South Dakota	13,558,972	303,545	511,234	14,377,751
Wyoming	8,971,680	941,137	2,827,254	12,740,071
TOTALS	33,384,530	2,266,945	5,615,322	41,270,796

[a]Production of AUMs was based on the assumption that private grazing lands were grazed to capacity. Production of private AUMs was based on carrying capacities that were not adjusted for leafy spurge infestations.
[b]Only AUMs reported by state land departments were included. AUMs leased by other state departments or agencies were not included.
[c]Only AUMs reported by the Bureau of Land Management and the United States Forest Service were included.

Valuation of Grazing

The value of grazing was estimated to determine the value of lost grazing capacity from leafy spurge infestations. Leafy spurge infestations may affect cash rental rates and AUM values in local areas; however, information on the location and extent of these effects was not available.

This analysis assumed that cash rental rates, carrying capacities, and AUM values have not been affected by leafy spurge infestations. Results using these assumptions may underestimate the value of AUMs (i.e., if leafy spurge substantially limits the supply of AUMs, substitutes to AUMs are not used, and cash rents are not adjusted for grazing losses) and underestimate the amount of lost income to ranchers and landowners.

Two methods of estimating the value of grazing were compared: (1) land rental rates and (2) ranch budgeting. Both methods provide reliable estimates of AUM values assuming leafy spurge has not affected AUM values.

Grazing Land Rental Rates

Land rental rates (cash rents) are used extensively in grazing land leases (Peterson and Janssen 1988; Janssen et al. 1990). Grazing land leases typically involve a fixed payment per acre for the grazing season, even though the specific arrangements or responsibilities of the landlord and tenant may vary. Lease rates or cash rents are an analytically attractive measure of the value of grazing since (1) they should closely approximate the contribution of a unit of grazing to a rancher's income under conditions of a competitive market, (2) variations among land tracts or areas should reflect differences in productivity, and (3) they should reflect differences in profitability of livestock production, in addition to changes in supply and demand for grazing lands. Cash rent estimates by county for each state were available for the last five years.

Published estimates of county-level rangeland or pasture cash rents were not available. Thus, unpublished private grazing land cash rents were obtained from the USDA-ERS's ASCS survey data for 1982 through 1990. The source of the data was a yearly land value survey of county ASCS offices. In accordance with disclosure guidelines set by the USDA-ERS, county-level data were prohibited from being published.

A five-year (1986 to 1990) average cash rent for rangeland was calculated for each county in the three states. The average cash rent was adjusted for inflation to reflect 1990 dollar equivalents. The value of private AUMs was estimated by dividing total private AUMs per county by total private acres per county

and dividing county-level per acre cash rent by the previous figure. The value of grazing was estimated at the county level; however, county-level rangeland cash rents and the value of grazing (dollars per AUM) were averaged by agricultural statistics districts for Montana, South Dakota, and Wyoming (Table 3) (see also Appendix D).

TABLE 3. AVERAGE RANGELAND CASH RENTS AND VALUE PER ANIMAL UNIT MONTH BY AGRICULTURAL STATISTICS DISTRICTS FOR MONTANA, SOUTH DAKOTA, AND WYOMING, 1986-1990

Agricultural Statistics Districts	Adjusted Weighted Average Rangeland Cash Rent Per Acre[a]	Value Per AUM[b]
	dollars	
MONTANA		
Central	5.36	16.43
North Central	2.77	10.88
North East	2.69	11.72
North West	5.29	15.83
South Central	3.03	11.45
South East	2.21	8.68
South West	4.95	17.20
State Average	3.40	12.52
SOUTH DAKOTA		
Central	10.94	15.00
East Central	17.70	15.13
West Central	7.03	12.59
North Central	17.70	15.79
North East	11.39	14.11
North West	4.86	9.41
South Central	8.12	11.92
South East	17.67	15.05
South West	3.66	7.73
State Average	7.37	11.98
WYOMING		
North East	3.15	9.42
North West	4.68	14.60
South Central	1.60	6.61
South East	3.67	10.93
West	4.11	8.93
State Average	3.10	10.04

[a]Average was calculated by weighting cash rent estimates by private grazing acres in each county. Cash rent estimates, 1986 through 1990, were adjusted for inflation to represent 1990 dollars using Consumer Price Index Inflators (U.S. Department of Labor, Bureau of Labor Statistics).

[b]Values for AUMs represent private values calculated from private acres and private AUMs. Value per AUM for each district was weighted by the total number of private AUMs produced in each county.

Although the value of public grazing (i.e., value of AUMs produced on public grazing lands) could be calculated from lease rates per acre and grazing charges per AUM, AUMs produced on public lands were assigned the same value as private AUMs. Since lease rates and charges for public AUMs tend to be less than the private grazing rates, public AUMs were assigned the private value of grazing to reflect more accurately the true economic value of public AUMs. By estimating the value of public AUMs based on private rates, the effects of leafy spurge infestations on public grazing lands should reflect an appropriate measure of the economic loss to ranchers and livestock producers.

Using a different value for public grazing, an alternative economic impact of leafy spurge infestation on grazing lands was estimated (Appendix E). The value of public AUMs was calculated using public lease rates and grazing charges. The alternative analysis of the economic effects of leafy spurge infestations on grazing lands, using the rates charged for public AUMs, represented a lower threshold of the economic impact.

Ranch Budgeting Approach

Cow-calf enterprise budgets were used as an alternative method to estimate the value of grazing. Leafy spurge infestations reduce grazing capacity, which corresponds to a proportionate reduction in herd size, assuming the supply of grazing lands is fixed in the short run. Herd size reductions lead directly to reductions in farm incomes (returns to operator labor, management, and equity). Dividing the reduced income by the decrease in available AUMs provides an alternative estimate of the value of AUMs.

Differences in herd size, management practices, and geographic conditions in the three states required the development of two budgets. Cow-calf operations in Montana and Wyoming were considered similar enough to use one enterprise budget; however, a separate budget was developed for cow-calf operations in South Dakota.

Hughes et al. (1989) developed a cow-calf budget generator to plan beef cow enterprise budgets. Production and marketing coefficients represented a specific level of production technology. The budget generator was used to calculate returns to labor, management, and equity for both Montana-Wyoming and South Dakota beef cow enterprises.

The model contains cash flow and economic cost sections for all expenses. Cash flow expenses represent actual "out-of-pocket" costs, and economic costs represent the opportunity cost of the resources used by the beef cow herd. For example, if a producer raises oats to feed the herd in a winter feeding program, the cost of raising the oats (tillage, seed, chemical)

would be the cash flow expense. The price the producer could receive for oats at the local elevator would be the opportunity cost of using the oats for feed. Opportunity costs generated by the budget were used in this analysis.

A 100-cow herd and a 260-cow herd were used for South Dakota and Wyoming-Montana, respectively. Cow-calf herd characteristics provided by Hughes et al. (1989) were used for South Dakota (Appendix F). Kearl et al. (1986) provided survey information about cow-calf herd characteristics in Wyoming which was used in the enterprise budgets for Wyoming and Montana (Appendix F).

Two leafy spurge infestation rates (25 and 50 percent) were used with the cow-calf budgets to calculate grazing values for AUMs. When 25 and 50 percent leafy spurge infestation rates were used, carrying capacities were reduced by 31 and 62.5 percent, respectively (Figure 4). Reducing required AUMs by 31 and 62.5 percent led to $3,468 and $3,729 reductions in income for the South Dakota cow-calf operation, respectively, and $7,082 and $8,914 reductions in income for the Wyoming-Montana cow-calf operation, respectively. Dividing the lost income by the number of lost AUMs provides another estimate of the grazing value of the lost AUMs (Table 4).

TABLE 4. VALUE PER ANIMAL UNIT MONTH FOR SOUTH DAKOTA, WYOMING, AND MONTANA CALCULATED USING COW-CALF ENTERPRISE BUDGETS WITH 25 AND 50 PERCENT LEAFY SPURGE INFESTATION LEVELS, 1990

Infestation Level	Number of Cows	Required AUMs	Returns to Labor Mngt & Equity	Change in Income	Change in AUMs	Value of AUMs
percent	head	-AUMs-	------ dollars ------		-AUMs-	dollars
South Dakota						
0	100	925	9,129	---	---	---
25	69	636	5,661	3,468	289	12.00
50	37	347	1,932	3,729	289	12.90
Wyoming-Montana						
0	260	2,428	21,045	---	---	---
25	179	1,669	13,963	7,082	759	9.33
50	97	910	5,049	8,914	759	11.74

The two approaches result in similar values for grazing AUMs. The budget approach for South Dakota valued grazing AUMs at $12 and $12.90, and the cash rent approach valued grazing AUMs from $7.73 to $15.79, with a state average of $11.98 per AUM. The budget approach for Wyoming-Montana valued grazing AUMs at

$9.33 and $11.74, and the cash rent approach valued grazing AUMs from $6.61 to $14.60 for Wyoming and $8.68 to $17.20 for Montana, with state averages of $10.04 and $12.52 for Wyoming and Montana, respectively. The cash rent method of valuing grazing AUMs was adopted for subsequent analyses because its values were similar to the budget approach and it reflected county and regional variations in AUM values.

Economic Impacts to Ranchers and Landowners

The economic impacts of leafy spurge to ranchers and landowners included reduced income from reductions in grazing capacity, foregone livestock sales (from lost grazing capacity), and reduced grazing land values from leafy spurge infestations. The economic impacts were estimated by calculating the following: (1) the direct loss of grazing AUMs, (2) the value of foregone livestock sales, and (3) the reduction in grazing land values. Only the direct loss of grazing AUMs was used in subsequent analyses. Other impacts to ranchers and landowners were included for conceptual completeness.

Value of Foregone Grazing Capacity

Several steps were used to estimate the value of lost grazing. First, the percent of leafy spurge infestation for each county was estimated by dividing the number of acres of leafy spurge by the total number of grazing acres. Second, the Carrying Capacity Reduction Model (Figure 4) was used with the percent of leafy spurge infestation and the total number of AUMs to estimate the number of lost AUMs for each county. Finally, the value of lost grazing for each county was estimated by applying the value per AUM to the number of lost AUMs.

The value of lost grazing was determined at the county level; however, for reasons of disclosure, the total value of lost AUMs was summed by agricultural statistics districts for each state (Table 5). Ranchers and landowners in Montana, South Dakota, and Wyoming lost $2.2 million, $1.4 million, and $220,000, respectively, in foregone income due to reduced carrying capacity from leafy spurge infestations on grazing lands in 1990.

TABLE 5. VALUE OF LOST GRAZING CAPACITY DUE TO LEAFY SPURGE INFESTATIONS IN MONTANA, SOUTH DAKOTA, AND WYOMING BY AGRICULTURAL STATISTICS DISTRICTS, 1990

Agricultural Statistics Districts	Number of Lost AUMs	Value of Lost Grazing[a]
		- dollars -
MONTANA		
Central	62,385	880,556
North Central	21,755	318,676
North East	15,989	212,204
North West	10,444	174,129
South Central	20,287	356,890
South East	8,060	74,386
South West	20,099	168,882
TOTAL	159,020	2,185,723
SOUTH DAKOTA		
Central	16,864	246,521
East Central	14,045	217,132
West Central	1,435	22,590
North Central	8,250	131,004
North East	32,725	468,476
North West	840	8,517
South Central	1,410	21,382
South East	20,486	314,118
South West	257	1,777
TOTAL	96,313	1,431,516
WYOMING		
North East	22,809	191,412
North West	1,007	15,676
South Central	257	913
South East	540	7,347
West	463	6,043
TOTAL	25,075	221,391

[a]The value of lost AUMs for each region was calculated by summing the values of lost AUMs for each county in the region.

Value of Foregone Livestock Sales

The value of lost livestock sales was derived from the number of lost AUMs. In 1990, Montana, South Dakota, and Wyoming lost about 159,000, 96,000, and 25,000 AUMs, respectively, from leafy spurge infestations. The AUMs lost in Montana, South Dakota, and Wyoming would support beef herds of 17,032, 10,424, and 2,685 cows, respectively. The beef herds that could have been supported on the lost AUMs in 1990 could have generated $6.9 million, $4.6 million, and $1.1 million in livestock sales in Montana, South Dakota, and Wyoming, respectively.

Reduced herd sizes were assumed to have no effect on cattle prices. If the entire impact of current levels of leafy spurge infestations was absorbed by producers in the three states in 1990, the inventory of cattle and calves in the United States would decrease only 0.03 percent (based on the 1987 Census of Agriculture inventory of cattle and calves). However, the entire impact of leafy spurge is not absorbed in a single production year.

Leafy spurge infestations have been increasing over time; thus, livestock production has been decreasing by a very small percentage each year (i.e., the loss of livestock production in 1991 would be related to the number of AUMs lost from increased leafy spurge infestations). Alternatively, if leafy spurge infestations increase 5 percent from 1990 to 1991 and decrease available AUMs by 10,000, lost livestock production in 1991 would be equal to the number of head that could be supported from the 10,000 lost AUMs. Leafy spurge infestations may affect livestock prices in local areas; however, information on the location and extent of these effects was not available.

Reduction in Grazing Land Values

Leafy spurge infestations reduce the productivity of grazing lands, which leads to lower land values in the absence of alternative uses. Although lower productivity usually affects agricultural land values, other important factors also affect land values. The interaction of these factors, along with the influences of leafy spurge infestations, are complex and beyond the scope of this report. Potential decreases in land values from leafy spurge infestations were estimated assuming all other determinants of land values remained unchanged.

Potential decreases in land values, which could be expected from current levels of leafy spurge infestations, were estimated using a value-to-rent ratio (1986 to 1990) for private grazing lands. The average rental rates for grazing lands in Montana, South Dakota, and Wyoming were compared with average sale prices (1986 to 1990) for grazing lands, by agricultural statistics districts, to determine a value-to-rent ratio. This ratio represents an approximation of the number of times rent is multiplied to achieve land value.

The value-to-rent ratio was applied to the estimated value of lost AUMs for each district in each state to determine the estimated reduction in grazing land values (Table 6). Grazing land values in Montana, South Dakota, and Wyoming were estimated to be reduced by $69.3 million, $16.4 million, and $5.3 million, respectively.

TABLE 6. ESTIMATED REDUCTION IN PRIVATE GRAZING LAND VALUES IN MONTANA, SOUTH DAKOTA, AND WYOMING DUE TO LEAFY SPURGE INFESTATIONS, 1990

Agricultural Statistics Districts	Grazing Lands[a]		Value-to-Rent Ratio	Value of lost AUMs	Loss of Grazing Land Value
	Cash Rent	Sale Price			
	--- dollars per acre ---			dollars	million dollars
MONTANA					
Central	5.36	103.72	19.34	880,556	17.030
North Central	2.77	156.36	56.41	318,676	17.977
North East	2.69	185.92	69.05	212,204	14.653
North West	5.29	173.30	32.77	174,129	5.706
South Central	3.03	71.13	23.51	356,890	8.390
South East	2.21	92.21	41.68	74,386	3.100
South West	4.95	70.63	14.27	168,882	2.410
State Average	3.40	118.21	34.77	2,185,723	69.266
SOUTH DAKOTA					
Central	10.94	125.25	11.45	246,521	2.823
East Central	17.70	189.69	10.72	217,132	2.328
West Central	7.03	69.49	9.89	22,590	0.223
North Central	11.39	139.82	12.28	131,004	1.609
North East	14.60	172.29	11.80	468,476	5.528
North West	4.86	69.05	14.20	8,517	0.121
South Central	8.12	102.56	12.62	21,382	0.270
South East	17.67	196.91	11.14	314,118	3.499
South West	3.66	68.55	18.74	1,777	0.033
State Average	7.37	90.79	12.31	1,431,516	16.434
WYOMING					
North East	3.15	74.67	23.70	191,412	4.536
North West	4.68	90.11	19.27	15,676	0.302
South Central	1.60	70.54	43.98	913	0.040
South East	3.67	70.41	19.20	7,347	0.141
West	4.11	187.74	45.73	6,043	0.276
State Average	3.10	81.24	26.17	221,391	5.295

[a]Cash rent and sale prices represent an average of 1986 through 1990 data adjusted for inflation. Cash rent and sale prices for each region were weighted by private acres in each county. Information was obtained from the Economic Research Service-Agricultural Stabilization and Conservation Service county-level survey of land values.

Leafy spurge infestations on grazing lands have both short-run and long-run implications. The most prevalent short-run effect leafy spurge infestations have on grazing lands should be a reduction in income. The long-run implications include reduced cash rents per acre, lower land values, and a tendency toward increased cash rent per AUM since the supply of AUMs is being reduced.

Reduced grazing land values can also affect property tax collections. Mill levies in some localities may increase to offset lower land values. If mill levies cannot be adjusted, tax collections may drop if land values become adversely affected. The problem with reduced land values becomes accentuated in rural jurisdictions where agricultural land comprises a large portion of the tax base, as may be the case with many areas of Montana, South Dakota, and Wyoming.

Direct and Secondary Impacts on the States' Economies

Economic impacts of a project, program, or policy can be categorized into direct and secondary impacts. The direct impacts are those changes in output, employment, or income that represent the initial or direct effects of the project or program. The secondary impacts (sometimes further categorized into indirect and induced effects) result from subsequent rounds of spending and respending within the economy. This process of spending and respending is sometimes termed the multiplier process, and the resultant secondary effects are sometimes referred to as multiplier effects (Leistritz and Murdock 1981).

Direct Impacts

The direct impacts to the state economies of Montana, South Dakota, and Wyoming can be summed from two sources: (1) the reduced income to ranchers and landowners from lost grazing capacity and (2) decreases in production outlays associated with ranchers' herd reductions. The reduced income to ranchers and landowners from lost grazing was calculated to be $2.2 million, $1.4 million, and $221,000 for Montana, South Dakota, and Wyoming, respectively (Table 5). Reductions in production expenditures were estimated by developing budgets using the cow-calf budget generator developed by Hughes et al. (1989) for cow-calf herds that could have been sustained by the AUMs lost to leafy spurge infestations.

The AUMs lost in Montana, South Dakota, and Wyoming could have supported beef herds of about 17,000, 10,400, and 2,700 cows, respectively. These cow-calf herds could have generated about $3.5 million, $2.4 million, and $557,000 in revenues to input suppliers and related businesses in Montana, South Dakota, and Wyoming, respectively (Appendix G). The total direct economic impacts (value of lost AUMs and expenditure reductions) of leafy spurge infestation on grazing lands in Montana, South Dakota, and Wyoming in 1990 were $5.719 million, $3.821 million, and $778,000, respectively. Ranchers were assumed to have not changed management practices in an attempt to compensate for lost AUMS (i.e., graze crop aftermath, put marginal cropland into pasture, or substitute extra hay or crop forage for lost AUMs).

Secondary Impacts

The secondary impacts of leafy spurge infestations on grazing lands in Montana, South Dakota, and Wyoming were estimated by using the North Dakota Input-Output Model (Coon et al. 1985). Input-Output (I-O) analysis is a mathematical tool that traces linkages among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector. The I-O model has 17 sectors, is closed with respect to households, and was developed from primary (survey) data from firms and households in North Dakota. This I-O model was deemed appropriate for measuring impacts in Montana, South Dakota, and Wyoming because (1) the economic structure of these three states is similar to that of North Dakota and (2) empirical testing has indicated that the North Dakota I-O coefficients are accurate in estimating changes in levels of economic activity for Montana and Wyoming (Chase et al. 1982; Coon et al. 1983).

The first step in calculating the secondary impacts was to allocate the direct impacts into the appropriate economic sectors (Table 7). Seven of the 17 sectors of the North Dakota Input-Output Model were used to allocate the direct impacts. Bull depreciation, which represents net purchases in the livestock sector, was included in the **agricultural livestock** sector. Hay, oats, and bedding expenses were included in the **agricultural crops** sector. Marketing expenses were included in the **transportation** sector under the assumption that shipping was the primary cost.

Utilities and general farm expenses were allocated to the **communication and public utility** sector. Veterinary care and medicine, mineral and salt, fly tags, power and fuel, protein supplement, miscellaneous supplies, and bull semen check expenses were included in the **retail trade** sector. Insurance for bulls and cows, along with interest on feed, bull purchases, and variable livestock expenses, were allocated to the **finance, insurance, and real estate** sector. The value of lost AUMs, which represents lost income for ranchers and landowners, was put into the **households** sector.

TABLE 7. BREAKDOWN OF THE DIRECT ECONOMIC IMPACTS INTO THE APPROPRIATE BASIC SECTORS OF THE INPUT-OUTPUT MODEL

Economic Sector Number	Name	Itemization of Direct Impacts
1	Ag Livestock	Bull Depreciation
2	Ag Crops	Hay, Oats, and Bedding Expenses
3	Nonmetal Mining	NA[a]
4	Construction	NA
5	Transportation	Marketing Expenses
6	Communications and Public Utilities	Utilities and General Farm Expenses
7	Ag Processing and Misc Manufacturing	NA
8	Retail Trade	Veterinary Care and Medicine, Mineral and Salt, Fly Tags, Worming Medicine, Power and Fuel, Protein Supplement, Miscellaneous Supplies, and Bull Semen Check Expenses
9	Finance, Insurance, and Real Estate	Bull Insurance, Cow Herd Insurance, and Interest on Feed, Bull Purchases, and Variable Livestock Expenses
10	Business and Personnel Service	NA
11	Professional and Social Service	NA
12	Households	Value of lost AUMs
13	Government	NA
14	Coal Mining	NA
15	Electricity Generation	NA
16	Petroleum Exploration and Extraction	NA
17	Petroleum Refining	NA

[a]Not applicable--no direct impacts were allocated to these sectors.

After the direct impacts were matched up with the appropriate economic sectors, the dollar amount of direct impacts were allocated by sector for Montana, South Dakota, and Wyoming (Table 8). **Households, retail trade,** and **finance, insurance, and real estate** sectors collectively averaged over 70 percent of total direct impacts.

Using the North Dakota I-O Model, total direct impacts of about $5.7 million from leafy spurge infestations in Montana generated about $13 million in secondary impacts to the state's economy, which included about $4.4 million of reduced income in the **households** sector and $4 million and $858,000 of reduced business activity in the **retail trade** and **finance, insurance, and real estate** sectors, respectively (Table 9).

TABLE 8. DOLLAR AMOUNT OF THE DIRECT IMPACTS ALLOCATED TO THE BASIC SECTORS OF THE INPUT-OUTPUT MODEL FOR MONTANA, SOUTH DAKOTA, AND WYOMING, 1990

Economic Sector Number	Name	Amount of Direct Impacts Montana	South Dakota	Wyoming
		dollars		
1	Ag Livestock	231,330	149,141	36,488
2	Ag Crops	1,854,067	1,361,343	292,285
5	Transportation	110,708	67,756	17,453
6	Communications and Public Utilities	119,224	72,968	18,795
8	Retail Trade	667,843	403,794	105,284
9	Finance, Insurance, and Real Estate	550,342	334,283	86,781
12	Households	2,185,723	1,431,516	221,391
	TOTAL DIRECT IMPACTS	5,719,237	3,820,801	778,477

Total direct impacts of about $3.8 million from leafy spurge infestations in South Dakota generated about $8.8 million dollars in secondary impacts to the state's economy, which included $2.9 million in lost income in the **households** sector and $2.7 million and $579,000 of reduced business activity in the **retail trade** and **finance, insurance, and real estate** sectors, respectively (Table 10).

Total direct impacts of $778,000 from leafy spurge infestations on grazing lands in Wyoming generated nearly $1.8 million in secondary impacts to the state's economy. The secondary impacts in Wyoming were greatest in the **households** ($618,000), **retail trade** ($534,000), and **finance, insurance, and real estate** ($114,000) sectors (Table 11).

In addition to estimating income and business activity, the North Dakota I-O Model also generates secondary employment estimates. These employment estimates are part of the secondary impacts and represent the number of jobs lost as a result of the direct and secondary impacts. The direct impacts from leafy spurge infestations in Montana, South Dakota, and Wyoming caused a reduction in total employment of 187, 131, and 22 jobs in 1990, respectively.

TABLE 9. DIRECT, SECONDARY, AND TOTAL ECONOMIC IMPACTS TO MONTANA'S ECONOMY ASSOCIATED WITH LEAFY SPURGE INFESTATIONS ON GRAZING LANDS, 1990

	Sector	Economic Impacts of Leafy Spurge Infestation		
		Direct	Secondary	Total
		dollars (000s)		
1	Ag Livestock	231	442	673
2	Ag Crops	1,854	365	2,219
3	Nonmetal Mining	0	33	33
4	Construction	0	438	438
5	Transportation	111	61	172
6	Comm and Pub Util	119	536	655
7	Ag Proc and Misc Mfg	0	597	597
8	Retail Trade	668	3,965	4,633
9	Fin, Ins, and Real Estate	550	858	1,408
10	Bus and Pers Service	0	336	336
11	Prof and Soc Service	0	426	426
12	Households	2,186	4,350	6,536
13	Government	0	562	562
14	Coal Mining	0	0	0
15	Elec Generation	0	0	0
16	Ptrlm Expl and Extr	0	0	0
17	Petroleum Refining	0	0	0
	TOTALS	5,719	12,969	18,688

34

TABLE 10. DIRECT, SECONDARY, AND TOTAL ECONOMIC IMPACTS TO SOUTH DAKOTA'S ECONOMY ASSOCIATED WITH LEAFY SPURGE INFESTATIONS ON GRAZING LANDS, 1990

	Sector	Economic Impacts of Leafy Spurge Infestation		
		Direct	Secondary	Total
		dollars (000s)		
1	Ag Livestock	149	295	444
2	Ag Crops	1,361	250	1,611
3	Nonmetal Mining	0	22	22
4	Construction	0	295	295
5	Transportation	68	40	108
6	Comm and Pub Util	73	357	430
7	Ag Proc and Misc Mfg	0	410	410
8	Retail Trade	404	2,683	3,087
9	Fin, Ins, and Real Estate	334	579	913
10	Bus and Pers Service	0	227	227
11	Prof and Soc Service	0	284	284
12	Households	1,432	2,935	4,367
13	Government	0	376	376
14	Coal Mining	0	0	0
15	Elec Generation	0	0	0
16	Ptrlm Expl and Extr	0	0	0
17	Petroleum Refining	0	0	0
	TOTALS	3,821	8,753	12,576

TABLE 11. DIRECT, SECONDARY, AND TOTAL ECONOMIC IMPACTS TO WYOMING'S ECONOMY ASSOCIATED WITH LEAFY SPURGE INFESTATIONS ON GRAZING LANDS, 1990

	Sector	Economic Impacts of Leafy Spurge Infestation		
		Direct	Secondary	Total
		dollars (000s)		
1	Ag Livestock	36	62	98
2	Ag Crops	292	55	347
3	Nonmetal Mining	0	4	4
4	Construction	0	58	58
5	Transportation	17	9	26
6	Comm and Pub Util	19	71	90
7	Ag Proc and Misc Mfg	0	89	89
8	Retail Trade	105	534	639
9	Fin, Ins, and Real Estate	87	114	201
10	Bus and Pers Service	0	46	46
11	Prof and Soc Service	0	55	55
12	Households	221	618	839
13	Government	0	75	75
14	Coal Mining	0	0	0
15	Elec Generation	0	0	0
16	Ptrlm Expl and Extr	0	0	0
17	Petroleum Refining	0	0	0
	TOTALS	777	1,790	2,567

Total direct impacts of about $10.3 million annually from leafy spurge infestations on grazing lands in Montana, South Dakota, and Wyoming generated about $23.5 million in secondary impacts to the states' economies. Direct and secondary impacts from current levels of leafy spurge in Montana, South Dakota, and Wyoming in 1990 approached $34 million.

FUTURE IMPACTS

Leafy spurge will continue to cause serious problems for ranchers and producers until economical and effective control methods are developed. Since current levels of leafy spurge infestations have substantial economic impacts, ranchers, landowners, and policymakers are concerned about potential future impacts and problems this weed presents. An estimate of the future impacts of leafy spurge was developed in an attempt to show how severe the leafy spurge problem could become.

Stroh et al. (1990) developed a simplified model, based on literature review and synthesis, to estimate the spread of leafy spurge patches. The model is based on the premise that a single leafy spurge plant, growing in competition with native grasses, will begin to spread vegetatively after four years and estimates that the radius of leafy spurge patches will expand at a rate of two feet annually.

The model assumes uninterrupted expansion with no constraints such as other weed patches, cropland boundaries, water boundaries, roadways, or other natural or man-made obstacles and did not estimate the number of new patches that would be established by seed dispersal (e.g., seeds spread by birds, water, animals, and man).

Leafy spurge infestations in Montana, South Dakota, and Wyoming were assumed to grow unrestricted for five years, using the leafy spurge growth model developed by Stroh et al. (1990). Several key assumptions were used to estimate the potential level of leafy spurge infestation in 1995: (1) Current acreage of leafy spurge was broken into quarter acre equivalents to estimate growth. (2) Spread was estimated from existing acreage only; increased acreage from the establishment of new patches was not considered. (3) Current leafy spurge infestations were allowed to spread devoid of restrictions (i.e., no natural and man-made barriers limiting spread and no biological, cultural, or chemical treatments curtailing growth).

Potential leafy spurge infestations in 1995 were estimated, along with reductions in grazing capacity, rancher and landowner incomes, and impacts to the states' economies. Economic impacts in 1995 were estimated based on two assumptions: (1) values for AUMs, livestock, and producer expenses were kept at 1990 levels and (2) the supply of grazing lands and grazing land carrying capacities did not change.

Leafy spurge infestations could increase 37 percent by 1995, based on growth conditions and assumptions outlined previously (Table 12). In addition to substantial increases in leafy spurge acreage, loss of grazing capacity and loss of income to ranchers and landowners also increased substantially. Direct impacts annually from leafy spurge infestations in 1995 could reach $7.8 million, $5.2 million, and $1.1 million in Montana, South Dakota, and Wyoming, respectively. Secondary impacts in 1995 could reach $17.8 million, $12 million, and $2.4 million in Montana, South Dakota, and Wyoming, respectively. Total economic impacts in the three states could reach over $46 million annually by 1995, a 37 percent increase in just five years.

TABLE 12. POTENTIAL IMPACTS OF LEAFY SPURGE INFESTATIONS ON GRAZING LANDS IN MONTANA, SOUTH DAKOTA, AND WYOMING IN 1995[a]

State	Leafy Spurge Acres 1990	Leafy Spurge Acres 1995	Lost Grazing Capacity	Potential Economic Impacts Direct	Potential Economic Impacts Secondary	Potential Economic Impacts Total
			- AUMs -	------- dollars (000s) -------		
Montana	431,162	590,099	217,639	7,800	17,800	25,600
South Dakota	79,863	109,302	131,816	5,200	12,000	17,200
Wyoming	61,292	83,886	34,318	1,100	2,400	3,500
TOTALS	572,317	783,287	383,773	14,100	32,200	46,300

[a]Potential expansion of leafy spurge in 1995 was estimated using a leafy spurge growth model developed by Stroh et al. (1990). Leafy spurge was assumed to expand without territorial limitations or restrictions from control mechanisms. Acreage from new spurge infestations was not considered. Current prices and costs were used, and no changes in grazing acres and carrying capacities were assumed.

SUMMARY AND CONCLUSIONS

Leafy spurge is a serious concern for land managers and operators of non-tilled agricultural land and other non-tilled land (e.g., parks, watersheds, lake shores, road ditches). The weed thrives in non-tilled agricultural land, especially in native rangeland, where it crowds out vegetation and restricts cattle from grazing grasses and forages. Leafy spurge is characterized as having a prolific ability to spread, adapts itself to a wide variety of growing conditions, and possesses a resilient capacity to withstand most economical chemical treatments.

This plant's persistent and aggressive nature, combined with current infestation rates in many areas of the Northern Great Plains, has prompted producers and policymakers to express concerns about the amount of resources that should be devoted to developing viable leafy spurge control technologies. Economic information on leafy spurge infestations should help to understand the importance of leafy spurge control and should provide useful information about allocating resources to develop new control technologies.

The purpose of this report was to estimate the economic impacts (direct and secondary effects) of leafy spurge infestations to landowners and ranchers and to the state economies of Montana, South Dakota, and Wyoming. Information was gathered on the number of acres of private grazing lands, acres of leafy spurge, rangeland carrying capacities, acres and AUMs

from state and federal grazing lands, rangeland cash rents, and cow-calf production budgets for Montana, South Dakota, and Wyoming.

Grazing capacity, leafy spurge infestation rates, and value of AUMs were used to estimate the direct impacts to ranchers and landowners. Direct impacts to ranchers and landowners included lost income from AUMs lost to leafy spurge infestations, reduced land values associated with reduced rangeland productivity, and lost livestock sales due to lost grazing capacity. Ranchers and landowners in Montana, South Dakota, and Wyoming lost $2.2 million, $1.4 million, and $220,000, respectively, in foregone income due to reduced carrying capacity from leafy spurge infestations on grazing lands in 1990. The lost AUMs in 1990 could have generated $6.9 million, $4.6 million, and $1.1 million in livestock sales in Montana, South Dakota, and Wyoming, respectively. Grazing land values in Montana, South Dakota, and Wyoming were reduced an estimated $69.3 million, $16.4 million, and $5.3 million, respectively.

Leafy spurge infestations on grazing lands in Montana, South Dakota, and Wyoming had substantial economic impacts (both direct and secondary) on the states' economies. Leafy spurge infestations caused $5.7 million, $3.8 million, and $778,000 in lost income and foregone business activity in Montana, South Dakota, and Wyoming, respectively. The North Dakota Input-Output Model was used to estimate that leafy spurge infestations generated secondary impacts of $13 million, $8.8 million, and $1.8 million in lost income and foregone business activity in Montana, South Dakota, and Wyoming, respectively. Direct and secondary impacts of $18.7 million, $12.6 million, and $2.6 million in lost income and business activity, in addition to a loss of 187, 131, and 22 jobs, show that leafy spurge is definitely a problem and a serious threat to rangeland production in the Northern Great Plains.

Leafy spurge was allowed to spread uncontested for five years, using a growth model developed by Stroh et al. (1990). Leafy spurge acreage in Montana, South Dakota, and Wyoming increased almost 37 percent. Leafy spurge infestations were allowed to spread without restrictions; however, acreage consumed by new patches was not considered. Levels of leafy spurge infestations could increase substantially in five years, and total economic impacts (loss of income and business activity) in Montana, South Dakota, and Wyoming could reach $46 million annually by 1995.

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APPENDIX A

Leafy Spurge Infestation Rates

APPENDIX TABLE A1. ACRES OF LEAFY SPURGE INFESTATION BY COUNTY ON GRAZING LANDS IN MONTANA, SOUTH DAKOTA, AND WYOMING, 1990

Montana		South Dakota		Wyoming	
County	Acres	County	Acres	County	Acres
Beaverhead	40	Aurora	0	Albany	66
Big Horn	1,214	Beadle	0	Big Horn	10
Blaine	6,000	Bennett	78	Campbell	350
Broadwater	3,000	Bon Homme	200	Carbon	950
Carbon	.	Brookings	1,750	Converse	275
Carter	2,500	Brown	2,000	Crook	35,000
Cascade	25,000	Brule	16,600	Fremont	4,000
Chouteau	20,000	Buffalo	0	Goshen	350
Custer	10,000	Butte	0	Hot Springs	5
Daniels	300	Campbell	1,400	Johnson	3,550
Dawson	5,000	Charles Mix	120	Laramie	600
Deer Lodge	20,603	Clark	1,900	Lincoln	1,800
Fallon	3,500	Clay	1,550	Natrona	35
Fergus	10,000	Codington	5,025	Niobrara	50
Flathead	50	Corson	25	Park	15
Gallatin	1,000	Custer	310	Platte	175
Garfield	0	Davison	650	Sheridan	13,895
Glacier	100	Day	200	Sublette	1
Golden Valley	.	Deuel	3,000	Sweetwater	0
Granite	800	Dewey	170	Teton	0
Hill	103	Douglas	500	Uinta	165
Jefferson	1,000	Edmunds	1,500	Washakie	1
Judith Basin	75,000	Fall River	18	Weston	0
Lake	647	Faulk	5		
Lewis & Clark	1,000	Grant	6,000	State	61,292
Liberty	70	Gregory	495		
Lincoln	1	Haakon	0		
Madison	50,000	Hamlin	1,500		
McCone	1	Hand	500		
Meagher	3,000	Hanson	700		
Mineral	7,680	Harding	450		
Missoula	4,900	Hughes	0		
Musselshell	50	Hutchinson	200		
Park	4,500	Hyde	125		
Petroleum	.	Jackson	0		
Phillips	18,000	Jerauld	150		
Pondera	20,000	Jones	150		
Powder River	5,000	Kingsbury	250		
Powell	.	Lake	300		
Prairie	763	Lawrence	950		
Ravalli	500	Lincoln	1,600		
Richland	10,000	Lyman	0		
Roosevelt	30,000	Marshall	6,680		
Rosebud	350	McCook	3,100		
Sanders	840	McPherson	1,500		
Sheridan	450	Meade	1,200		
Silver Bow	9,240	Mellette	0		
Stillwater	5,000	Miner	300		
Sweet Grass	50,000	Minnehaha	60		
Teton	3,000	Moody	366		
Toole	4,000	Pennington	500		
Treasure	10	Perkins	700		
Valley	9,000	Potter	2		
Wheatland	5,000	Roberts	1,050		
Wibaux	2,800	Sanborn	2,175		
Yellowstone	150	Shannon	110		
		Spink	2,223		
State	431,162	Stanley	300		
		Sully	1		
		Todd	100		
		Tripp	850		
		Turner	6,635		
		Union	550		
		Walworth	250		
		Yankton	800		
		Ziebach	40		
		State	79,863		

APPENDIX TABLE A2. LEAFY SPURGE INFESTATION AS A PERCENT OF TOTAL GRAZING ACRES BY COUNTY IN MONTANA, SOUTH DAKOTA, AND WYOMING, 1990

Montana		South Dakota		Wyoming	
County	Percent Infestation	County	Percent Infestation	County	Percent Infestation
Carbon	No Data	Roberts	0	Weston	0
Golden Valley	No Data	Sully	0	Teton	0
Petroleum	No Data	Beadle	0	Sweetwater	0
Powell	No Data	Tripp	0	Sublette	0
Garfield	0	Gregory	0	Washakie	0
McCone	0	Walworth	0	Hot Springs	0
Lincoln	0	Aurora	0	Big Horn	0.001
Beaverhead	0.002	Jerauld	0	Natrona	0.001
Treasure	0.002	Grant	0	Park	0.001
Musselshell	0.005	Fall River	0	Albany	0.003
Glacier	0.008	McPherson	0.002	Niobrara	0.003
Rosebud	0.011	Stanley	0.006	Converse	0.009
Yellowstone	0.013	Faulk	0.007	Campbell	0.011
Hill	0.017	Shannon	0.008	Uinta	0.012
Liberty	0.019	Corson	0.011	Platte	0.013
Flathead	0.035	Lincoln	0.014	Carbon	0.017
Big Horn	0.053	Butte	0.014	Goshen	0.032
Prairie	0.071	Meade	0.015	Laramie	0.042
Daniels	0.076	Dewey	0.018	Fremont	0.082
Lewis & Clark	0.107	Harding	0.021	Lincoln	0.093
Carter	0.119	Charles Mix	0.032	Johnson	0.125
Sheridan	0.132	Custer	0.039	Sheridan	0.798
Lake	0.180	Brule	0.041	Crook	2.273
Jefferson	0.186	Pennington	0.057		
Gallatin	0.198	Perkins	0.065		
Powder River	0.233	McCook	0.067		
Granite	0.236	Brown	0.093		
Ravalli	0.237	Haakon	0.098		
Blaine	0.244	Buffalo	0.099		
Meagher	0.313	Marshall	0.116		
Sanders	0.337	Todd	0.134		
Custer	0.386	Ziebach	0.137		
Valley	0.420	Lawrence	0.141		
Fallon	0.425	Davison	0.298		
Dawson	0.523	Mellette	0.305		
Fergus	0.534	Campbell	0.314		
Teton	0.576	Hand	0.355		
Wheatland	0.658	Spink	0.365		
Park	0.671	Yankton	0.367		
Broadwater	0.677	Miner	0.505		
Wibaux	0.685	Jackson	0.601		
Phillips	0.699	Lyman	0.604		
Toole	0.757	Edmunds	0.651		
Stillwater	0.774	Deuel	0.671		
Richland	1.357	Day	0.729		
Chouteau	1.738	Bon Homme	0.740		
Cascade	2.396	Hamlin	0.746		
Missoula	2.579	Codington	0.850		
Madison	3.131	Moody	0.868		
Silver Bow	4.720	Hutchinson	1.255		
Roosevelt	5.032	Clark	1.365		
Pondera	5.969	Bennett	1.449		
Sweet Grass	6.373	Douglas	1.459		
Judith Basin	11.311	Hughes	1.555		
Deer Lodge	15.325	Jones	1.726		
Mineral	53.609	Minnehaha	1.933		
		Kingsbury	2.281		
		Sanborn	2.517		
		Brookings	2.770		
		Potter	3.494		
		Clay	3.813		
		Turner	4.236		
		Hanson	4.373		
		Hyde	5.954		
		Lake	21.082		

Union	24.713

APPENDIX B

Grazing Acres by County

APPENDIX TABLE B1. ACRES BY COUNTY OF PRIVATE AND PUBLIC GRAZING LANDS IN MONTANA, 1990

County	Private Pasture & Rangeland[a]	State Grazing Land[b]	Federal Rangeland[c]		Total Acres
			BLM	Forest Service	
Beaverhead	1,243,458	324,923	662,011	325,553	2,555,945
Big Horn	2,181,163	87,013	27,646	0	2,295,822
Blaine	1,838,172*	164,855	454,494	0	2,457,521
Broadwater	301,598	20,277	65,946	55,285	443,106
Carbon	336,020	36,681	207,411	38,159	618,271
Carter	1,387,382	139,491	506,895	71,746	2,105,514
Cascade	926,634	60,494	24,784	31,471	1,043,383
Chouteau	831,117*	179,787	128,668	10,954	1,150,526
Custer	2,114,961*	133,374	339,085	0	2,587,420
Daniels	282,860*	112,489	200	0	395,549
Dawson	820,743	70,024	64,715	0	955,482
Deer Lodge	89,372	6,717	5,520	32,828	134,437
Fallon	647,145	57,422	119,238	0	823,805
Fergus	1,370,263	137,049	354,563	10,643	1,872,518
Flathead	91,145	21,764	19	29,991	142,919
Gallatin	392,714	35,478	8,514	67,166	503,872
Garfield	1,693,247	161,207	493,491	0	2,347,945
Glacier	1,237,168**	5,206	1,083	5,048	1,248,505
Golden Valley	494,834	44,893	7,961	2,875	550,563
Granite	203,010	16,629	44,868	74,230	338,737
Hill	521,171	87,506	14,206	0	622,883
Jefferson	276,560	29,155	97,094	135,280	538,089
Judith Basin	549,383	79,912	11,850	21,906	663,051
Lake	350,030	9,635	0	0	359,665
Lewis & Clark	672,048	123,220	72,244	68,650	936,162
Liberty	305,147	57,974	7,413	0	370,534
Lincoln	16,028	14,226	0	183,360	213,614
Madison	1,000,225	119,280	252,632	224,991	1,597,128
McCone	693,095	79,226	200,822	0	973,143
Meagher	773,391*	86,735	8,629	89,790	958,545
Mineral	1,066	4,117	0	9,143	14,326
Missoula	87,952	40,652	13,595	47,761	189,960
Musselshell	758,287	71,438	104,737	0	934,462
Park	570,164	29,293	10,002	60,785	670,244
Petroleum	638,487*	62,215	336,102	0	1,036,804
Phillips	1,311,939	174,918	1,089,245	0	2,576,102
Pondera	301,315	30,508	1,289	1,961	335,073
Powder River	1,460,785	137,008	260,547	283,194	2,141,534
Powell	450,600	54,445	85,110	42,941	633,096
Prairie	550,499	69,964	447,462	0	1,067,925
Ravalli	109,688	28,145	0	72,962	210,795
Richland	614,040	70,055	52,817	0	736,912
Roosevelt	575,705	16,320	4,197	0	596,222
Rosebud	2,650,585*	167,957	234,129	84,800	3,137,471
Sanders	213,663	20,415	0	15,067	249,145
Sheridan	310,401	30,415	261	0	341,077
Silver Bow	96,739	11,619	45,277	42,136	195,771
Stillwater	587,862*	38,660	6,120	13,643	646,285
Sweet Grass	705,104	45,520	16,392	17,600	784,616
Teton	404,138	87,659	19,884	9,454	521,135
Toole	428,547	72,495	27,688	0	528,730

- continued -

APPENDIX TABLE B1. ACRES BY COUNTY OF PRIVATE AND PUBLIC GRAZING LANDS IN MONTANA, 1990 (continued)

County	Private Pasture & Rangeland[a]	State Grazing Land[b]	Federal Rangeland[c]		Total Acres
			BLM	Forest Service	
Treasure	554,743*	35,346	12,108	0	602,197
Valley	932,839	190,544	1,019,645	0	2,143,028
Wheatland	676,687	68,912	1,275	12,592	759,466
Wibaux	356,273	25,607	26,995	0	408,875
Yellowstone	982,725	67,105	85,651	0	1,135,481
TOTAL	39,970,917	4,153,972	8,082,530	2,193,965	54,401,384

[a]Data were obtained from the 1987 Census of Agriculture, except for data marked with * denoting the 1982 Census of Agriculture and ** denoting the 1978 Census of Agriculture.
[b]Data were obtained from the Montana Department of State Lands, Helena, Montana.
[c]Bureau of Land Management leased grazing acres represent 1990 grazing season and were obtained from the Bureau of Land Management District Office, Billings, Montana. United States Forest Service leased grazing acres represent 1990 grazing season and were obtained from the United States Forest Service, Range Management Division, Washington, D.C.

APPENDIX TABLE B2. ACRES BY COUNTY OF PRIVATE AND PUBLIC GRAZING LANDS IN SOUTH DAKOTA, 1990

County	Private Pasture & Rangeland[a]	State Grazing Land[b]	Federal Rangeland[c]		Total Acres
			BLM	Forest Service	
Aurora	105,509	880	0	0	106,389
Beadle	187,266	0	0	0	187,266
Bennett	136,027	17,337	0	0	153,364
Bon Homme	40,504*	0	56	0	40,560
Brookings	49,979	556	0	0	50,535
Brown	178,868	4,134	0	0	183,002
Brule	188,323	7	532	0	188,862
Buffalo	201,798	0	0	0	201,798
Butte	832,426	88,876	145,485	0	1,066,787
Campbell	150,398	8,550	203	0	159,151
Charles Mix	185,013	40	122	0	185,175
Clark	109,512	412	0	0	109,924
Clay	9,588	0	11	0	9,599
Codington	58,805	0	0	0	58,805
Corson	1,221,640	30,794	0	31,443	1,283,877
Custer	359,263	10,903	3,680	388,774	762,620
Davison	40,336	0	0	0	40,336
Day	95,413	595	0	0	96,008
Deuel	67,062	0	0	0	67,062
Dewey	1,386,356	7,932	0	0	1,394,288
Douglas	34,272	0	0	0	34,272
Edmunds	216,359**	13,932	0	0	230,291
Fall River	844,182	20,873	7,347	268,556	1,140,958
Faulk	231,178**	13,967	0	0	245,145
Grant	71,615	0	0	0	71,615
Gregory	269,581	40	12	0	269,633
Haakon	853,526	13,232	1,400	0	868,158
Hamlin	26,800	0	0	0	26,800
Hand	483,813	8,555	0	0	492,368
Hanson	43,452	0	0	0	43,452
Harding	1,014,959*	275,571	29,880	52,446	1,372,856
Hughes	128,194	397	2	0	128,593
Hutchinson	55,771	0	0	0	55,771
Hyde	260,370	18,450	0	0	278,820
Jackson	999,089	4,188	240	99,768	1,103,285
Jerauld	126,560	0	0	0	126,560
Jones	362,631	4,080	3	20,304	387,018
Kingsbury	67,965	0	0	0	67,965
Lake	23,835	0	0	0	23,835
Lawrence	131,195*	0	5,350	253,143	389,688
Lincoln	14,425	0	0	0	14,425
Lyman	454,886	8,668	80	49,830	513,464
Marshall	104,360	2,987	20	0	107,367
McCook	37,237	0	0	0	37,237
McPherson	219,350	22,005	0	0	241,355
Meade	1,511,210	56,132	42,045	23,126	1,632,513
Mellette	481,058	10,310	0	0	491,368
Miner	61,389	0	0	0	61,389
Minnehaha	33,631	0	0	0	33,631
Moody	23,047	0	0	0	23,047
Pennington	806,976	0	17,573	569,512	1,394,061

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APPENDIX TABLE B2. ACRES BY COUNTY OF PRIVATE AND PUBLIC GRAZING LANDS IN SOUTH DAKOTA, 1990 (continued)

County	Private Pasture & Rangeland[a]	State Grazing Land[b]	Federal Rangeland[c]		Total Acres
			BLM	Forest Service	
Perkins	1,143,883	62,996	8,055	120,744	1,335,678
Potter	149,782	21,946	0	0	171,728
Roberts	100,378	0	0	0	100,378
Sanborn	119,177	0	0	0	119,177
Shannon	1,246,852*	0	0	0	1,246,852
Spink	133,053	2,493	0	0	135,546
Stanley	682,318**	9,554	16,435	0	708,307
Sully	163,615*	16,006	58	0	179,679
Todd	897,579	0	0	0	897,579
Tripp	452,057*	5,556	0	0	457,613
Turner	24,789	0	0	0	24,789
Union	8,801	0	0	0	8,801
Walworth	122,913	15,303	0	0	138,216
Yankton	29,585	0	359	0	29,944
Ziebach	1,151,331	17,632	202	118	1,169,283
TOTAL	22,023,115	795,889	279,150	1,877,764	24,975,918

[a]Data were obtained from the 1987 Census of Agriculture, except for data marked with * denoting the 1982 Census of Agriculture and ** denoting the 1978 Census of Agriculture. All values represent *Census of Agriculture* acres less 1990 state leased grazing lands and federal grazing lands under exclusive use by grazing associations.
[b]Data represent 1990 grazing season and were obtained from the South Dakota Department of School and Public Lands, Pierre, South Dakota.
[c]Bureau of Land Management leased grazing acres represent 1990 growing season and were obtained from the Bureau of Land Management District Office, Billings, Montana. United States Forest Service leased grazing acres represent 1990 growing season and were obtained from the United States Forest Service, Range Management Division, Washington, D.C.

APPENDIX TABLE B3. ACRES BY COUNTY OF PRIVATE AND PUBLIC GRAZING LANDS IN WYOMING, 1990

County	Private Pasture & Rangeland[a]	State Grazing Land[b]	Federal Rangeland[c]		Total Acres
			BLM	Forest Service	
Albany	1,683,447	219,899	302,632	428,102	2,634,080
Big Horn	297,244	72,492	1,107,270	338,206	1,815,212
Campbell	2,457,441*	200,508	236,067	158,002	3,052,018
Carbon	2,576,589	323,466	2,037,568	561,314	5,498,937
Converse	2,170,779	262,244	144,091	276,545	2,853,659
Crook	1,095,848	125,193	152,039	166,992	1,540,072
Fremont	2,010,538	250,928	2,086,376	528,698	4,876,540
Goshen	970,298	87,242	26,555	0	1,084,095
Hot Springs	972,279**	83,014	514,949	16,951	1,587,193
Johnson	1,856,390	223,114	510,972	239,297	2,829,773
Laramie	1,269,671*	154,012	10,182	0	1,433,865
Lincoln	430,274	105,864	1,014,315	378,734	1,929,187
Natrona	2,569,994	393,228	1,451,670	5,999	4,420,891
Niobrara	1,232,280*	164,335	124,245	840	1,521,700
Park	800,156	154,634	565,868	0	1,520,658
Platte	1,095,171	128,916	82,127	918	1,307,132
Sheridan	1,188,163	121,907	50,720	381,424	1,742,214
Sublette	422,458	114,060	1,257,529	505,222	2,299,269
Sweetwater	1,634,576	182,574	4,309,631	0	6,126,781
Teton	31,393	4,931	9,734	306,690	352,748
Uinta	764,098	49,759	529,035	0	1,342,892
Washakie	317,667	101,016	927,867	34,260	1,380,810
Weston	1,166,786	115,074	75,909	242,555	1,600,324
TOTAL	29,013,540	3,638,410	17,527,351	4,570,749	54,750,050

[a]Data were obtained from the 1987 Census of Agriculture, except for data marked with * denoting the 1982 Census of Agriculture and ** denoting the 1978 Census of Agriculture. All values represent *Census of Agriculture* acres less federal grazing lands under exclusive use by grazing associations.

[b]Data represent 1990 grazing season and were obtained from the Wyoming State Land and Farm Loan Office, Cheyenne, Wyoming.

[c]Bureau of Land Management leased grazing acres represent 1990 growing season and were obtained from the Bureau of Land Management District Office, Cheyenne, Wyoming. United States Forest Service leased grazing acres represent 1990 growing season and were obtained from the United States Forest Service, Range Management Division, Washington, D.C.

APPENDIX C

Animal Unit Months By County

APPENDIX TABLE C1. ANIMAL UNIT MONTHS ON PRIVATE, STATE, AND FEDERAL LANDS BY COUNTY, MONTANA, 1990

County	Adjusted Carrying Capacity[a]	Private Pasture & Rangeland	State Grazing Land[b]	Federal Rangeland[c]		Total AUMs
				BLM	Forest Service	
	AUMs per Acre	AUMs				
Beaverhead	0.291	361,500	91,445	80,541	76,523	610,009
Big Horn	0.313	683,623	22,629	4,100	0	710,351
Blaine	0.228	418,699	38,712	92,348	0	549,759
Broadwater	0.263	79,229	5,042	5,583	17,038	106,893
Carbon	0.246	82,669	8,045	30,758	7,175	128,647
Carter	0.254	351,712	33,139	87,124	32,357	504,332
Cascade	0.328	303,957	16,554	2,712	8,491	331,714
Chouteau	0.247	204,907	45,804	28,736	6,622	286,070
Custer	0.260	548,839	30,753	64,013	0	643,606
Daniels	0.226	63,982	31,684	45	0	95,710
Dawson	0.283	232,619	19,606	14,405	0	266,630
Deer Lodge	0.331	29,591	1,641	467	4,672	36,371
Fallon	0.281	182,037	15,186	26,542	0	223,765
Fergus	0.330	452,144	30,243	89,902	6,474	578,763
Flathead	0.331	30,178	3,122	1	3,794	37,094
Gallatin	0.291	114,170	10,199	721	25,805	150,895
Garfield	0.226	383,006	36,783	109,850	0	529,639
Glacier	0.313	387,604	1,339	119	2,092	391,154
Golden Valley	0.330	163,280	10,806	1,181	1,202	176,468
Granite	0.331	67,216	3,685	1,721	14,535	87,156
Hill	0.208	108,414	22,604	2,887	0	133,905
Jefferson	0.291	80,402	6,129	8,221	26,663	121,414
Judith Basin	0.479	263,348	26,184	3,005	18,840	311,377
Lake	0.337	118,108	1,529	0	0	119,637
Lewis & Clark	0.325	218,083	28,063	7,190	14,604	267,940
Liberty	0.228	69,516	15,332	811	0	85,659
Lincoln	0.331	5,307	1,066	0	10,265	16,637
Madison	0.291	290,787	30,818	30,735	74,892	427,232
McCone	0.325	225,508	19,308	44,702	0	289,519
Meagher	0.330	255,195	25,040	944	40,180	321,359
Mineral	0.331	353	359	0	1,231	1,943
Missoula	0.299	26,325	4,398	521	4,508	35,752
Musselshell	0.330	250,211	16,472	15,532	0	282,215
Park	0.258	147,305	8,628	847	19,229	176,009
Petroleum	0.206	131,396	12,024	85,221	0	228,640
Phillips	0.231	303,122	37,119	300,394	0	640,635
Pondera	0.241	72,481	8,166	141	1,118	81,906
Powder River	0.260	379,079	32,307	44,782	92,976	549,144
Powell	0.331	149,191	14,322	3,264	11,689	178,467
Prairie	0.301	165,765	17,849	99,604	0	283,218
Ravalli	0.334	36,584	4,783	0	8,186	49,553
Richland	0.221	135,476	19,612	11,757	0	166,845
Roosevelt	0.226	130,222	4,651	934	0	135,808
Rosebud	0.232	615,051	36,920	46,179	21,320	719,470
Sanders	0.331	70,743	3,142	0	4,875	78,760
Sheridan	0.181	56,325	7,933	58	0	64,316
Silver Bow	0.291	28,124	2,688	3,833	11,329	45,975
Stillwater	0.266	156,515	9,811	908	6,345	173,579
Sweet Grass	0.258	182,168	12,198	2,431	11,837	208,634
Teton	0.273	110,234	22,064	2,176	3,064	137,538
Toole	0.217	93,201	17,743	3,030	0	113,974

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APPENDIX TABLE C1. ANIMAL UNIT MONTHS ON PRIVATE, STATE, AND FEDERAL LANDS BY COUNTY, MONTANA, 1990 (continued)

County	Adjusted Carrying Capacity[a]	Private Pasture & Rangeland	State Grazing Land[b]	Federal Rangeland[c]		Total AUMs
				BLM	Forest Service	
	AUMs per Acre	AUMs				
Treasure	0.236	130,886	7,429	2,081	0	140,396
Valley	0.172	160,647	46,730	302,339	0	509,715
Wheatland	0.330	223,286	19,640	189	2,608	245,723
Wibaux	0.311	110,690	6,907	6,009	0	123,606
Yellowstone	0.217	212,868	15,878	12,702	0	241,448
TOTAL	-----	10,853,878	1,022,263	1,684,295	592,539	14,152,974

[a]Private rangeland carrying capacity was adjusted to reflect productivity differences between rangeland and pasture and to account for the ratio of pasture to rangeland acres in each county.

[b]Data were obtained from the Montana Department of State Lands, Helena, Montana.

[c]Bureau of Land Management leased AUMs represent 1990 grazing season and were obtained from the Bureau of Land Management District Office, Billings, Montana. United States Forest Service leased AUMs represent 1990 grazing season and were obtained from the United States Forest Service, Range Management Division, Washington, D.C.

APPENDIX TABLE C2. ANIMAL UNIT MONTHS ON PRIVATE, STATE, AND FEDERAL LANDS BY COUNTY, SOUTH DAKOTA, 1990

County	Adjusted Carrying Capacity[a]	Private Pasture & Rangeland	State Grazing Land[b]	Federal Rangeland[c]		Total AUMs
				BLM	Forest Service	
	AUMs per Acre	AUMs				
Aurora	0.78	82,322	605	0	0	82,927
Beadle	0.78	146,112	0	0	0	146,112
Bennett	0.56	76,847	7,986	0	0	84,833
Bon Homme	1.22	49,438	0	15	0	49,453
Brookings	1.20	60,209	0	0	0	60,209
Brown	0.79	142,038	2,909	0	0	144,948
Brule	0.78	146,937	3	145	0	147,086
Buffalo	0.72	144,325	0	0	0	144,325
Butte	0.42	347,615	22,113	39,763	0	409,490
Campbell	0.66	99,084	4,956	55	0	104,095
Charles Mix	1.07	198,674	17	33	0	198,724
Clark	1.03	113,299	376	0	0	113,675
Clay	1.47	14,068	0	3	0	14,071
Codington	1.03	60,839	0	0	0	60,839
Corson	0.57	696,976	11,782	0	18,081	726,839
Custer	0.51	184,231	3,529	1,006	55,361	244,126
Davison	1.06	42,744	0	0	0	42,744
Day	1.03	98,712	364	0	0	99,076
Deuel	1.03	69,381	0	0	0	69,381
Dewey	0.57	790,950	2,805	0	0	793,755
Douglas	1.07	36,803	0	0	0	36,803
Edmunds	0.73	157,174	10,047	0	0	167,221
Fall River	0.41	348,481	6,474	2,008	92,586	449,549
Faulk	0.73	167,939	9,947	0	0	177,886
Grant	1.03	74,092	0	0	0	74,092
Gregory	0.76	203,920	16	3	0	203,939
Haakon	0.57	484,700	5,515	383	0	490,597
Hamlin	1.03	27,727	0	0	0	27,727
Hand	0.72	346,020	5,343	0	0	351,363
Hanson	1.20	52,345	0	0	0	52,345
Harding	0.42	423,839	80,649	8,167	29,173	541,828
Hughes	0.65	83,345	219	1	0	83,565
Hutchinson	1.22	68,072	0	0	0	68,072
Hyde	0.72	186,215	11,881	0	0	198,096
Jackson	0.57	567,362	1,068	66	41,643	610,139
Jerauld	0.78	98,747	0	0	0	98,747
Jones	0.64	230,369	1,702	1	9,752	241,823
Kingsbury	1.20	81,875	0	0	0	81,875
Lake	1.20	28,713	0	0	0	28,713
Lawrence	0.52	67,608	0	1,462	8,111	77,181
Lincoln	1.47	21,166	0	0	0	21,166
Lyman	0.70	316,533	3,956	22	25,815	346,326
Marshall	1.03	107,969	2,290	5	0	110,265
McCook	1.20	44,858	0	0	0	44,858
McPherson	0.73	159,347	14,521	0	0	173,868
Meade	0.52	778,764	17,197	11,491	1,019	808,471
Mellette	0.64	305,602	3,910	0	0	309,512
Miner	1.20	73,954	0	0	0	73,954
Minnehaha	1.30	43,877	0	0	0	43,877
Moody	1.30	30,069	0	0	0	30,069
Pennington	0.52	415,855	0	4,803	84,080	504,738
Perkins	0.52	592,066	21,595	2,202	73,258	689,120
Potter	0.66	98,677	14,339	0	0	113,017
Roberts	1.03	103,850	0	0	0	103,850

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APPENDIX TABLE C2. ANIMAL UNIT MONTHS ON PRIVATE, STATE, AND FEDERAL LANDS BY COUNTY, SOUTH DAKOTA, 1990 (continued)

County	Adjusted Carrying Capacity[a]	Private Pasture & Rangeland	State Grazing Land[b]	Federal Rangeland[c]		Total AUMs
				BLM	Forest Service	
	AUMs per Acre	AUMs				
Sanborn	1.06	126,293	0	0	0	126,293
Shannon	0.51	639,389	0	0	0	639,389
Spink	0.79	105,656	1,730	0	0	107,386
Stanley	0.63	426,818	3,629	4,492	0	434,939
Sully	0.65	106,374	10,258	16	0	116,648
Todd	0.70	624,582	0	0	0	624,582
Tripp	0.70	314,565	3,410	0	0	317,974
Turner	1.32	32,736	0	0	0	32,736
Union	1.47	12,914	0	0	0	12,914
Walworth	0.66	80,976	9,672	0	0	90,648
Yankton	1.32	39,069	0	98	0	39,167
Ziebach	0.57	656,863	6,734	55	60	663,711
TOTAL	----	13,558,972	303,545	76,295	438,939	14,377,751

[a]Private rangeland carrying capacity was adjusted to reflect productivity differences between rangeland and pasture and to account for the ratio of pasture to rangeland acres in each county.

[b]Data were obtained from the South Dakota Department of School and Public Lands, Pierre, South Dakota.

[c]Bureau of Land Management leased AUMs represent 1990 grazing season and were obtained from the Bureau of Land Management District Office, Billings, Montana. United States Forest Service leased AUMs represent 1990 grazing season and were obtained from the United States Forest Service, Range Management Division, Washington, D.C.

APPENDIX TABLE C3. ANIMAL UNIT MONTHS ON PRIVATE, STATE, AND FEDERAL LANDS BY COUNTY, WYOMING, 1990

County	Adjusted Carrying Capacity[a]	Private Pasture & Rangeland	State Grazing Land[b]	Federal Rangeland[c]		Total AUMs
				BLM	Forest Service	
	AUMs per Acre	AUMs				
Albany	0.251	423,073	57,542	41,163	28,272	550,050
Big Horn	0.176	52,336	10,821	62,880	126,613	252,650
Campbell	0.321	788,113	59,808	29,824	40,785	918,530
Carbon	0.261	672,543	73,634	289,113	28,665	1,063,955
Converse	0.325	705,963	74,681	23,429	68,131	872,204
Crook	0.429	469,733	42,341	13,283	21,110	546,467
Fremont	0.353	709,820	49,914	187,225	27,527	974,486
Goshen	0.331	320,858	34,004	3,862	0	358,724
Hot Springs	0.191	185,679	19,281	57,784	1,111	263,855
Johnson	0.313	581,580	56,946	42,274	23,812	704,612
Laramie	0.284	360,851	50,856	1,420	0	413,127
Lincoln	0.418	179,650	26,198	84,288	54,113	344,249
Natrona	0.281	722,861	86,224	173,170	380	982,635
Niobrara	0.527	649,659	57,843	18,913	197	726,612
Park	0.296	236,828	42,811	81,514	0	361,153
Platte	0.194	212,928	39,388	10,006	567	262,889
Sheridan	0.355	422,303	44,066	6,954	133,361	606,684
Sublette	0.558	235,694	28,809	108,049	132,077	504,629
Sweetwater	0.140	229,111	20,267	635,096	0	884,474
Teton	0.777	24,404	3,862	409	22,481	51,156
Uinta	0.406	310,563	10,555	77,338	0	398,456
Washakie	0.454	144,222	21,509	84,846	21,919	272,496
Weston	0.285	332,907	29,777	11,967	51,326	425,977
TOTAL	-----	8,971,680	941,137	2,044,807	782,447	12,740,071

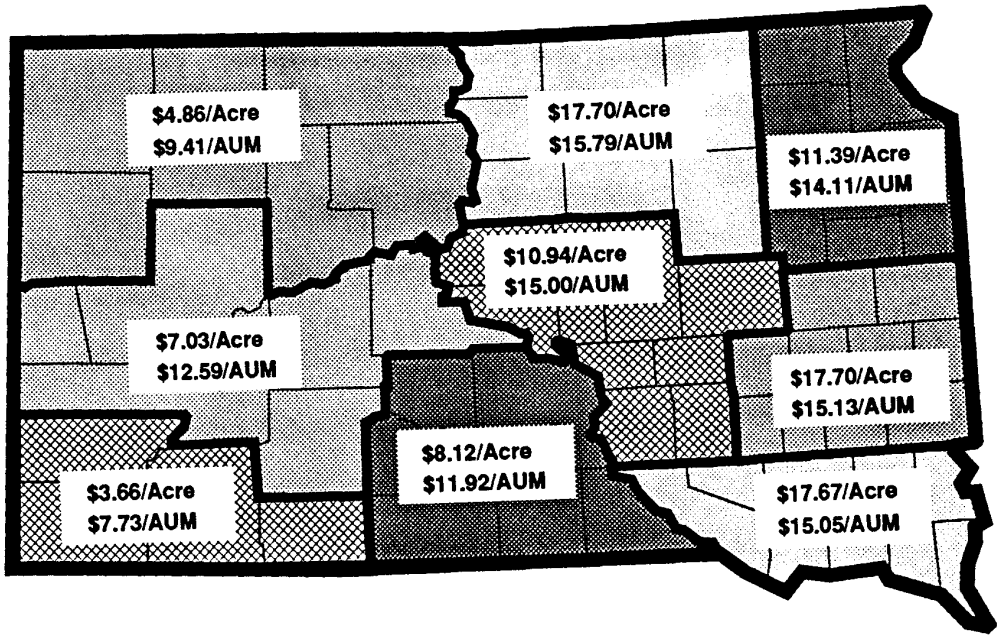
[a]Private rangeland carrying capacity was adjusted to reflect productivity differences between rangeland and pasture and to account for the ratio of pasture to rangeland acres in each county.

[b]Data were obtained from the Wyoming State Land and Farm Loan Office, Cheyenne, Wyoming.

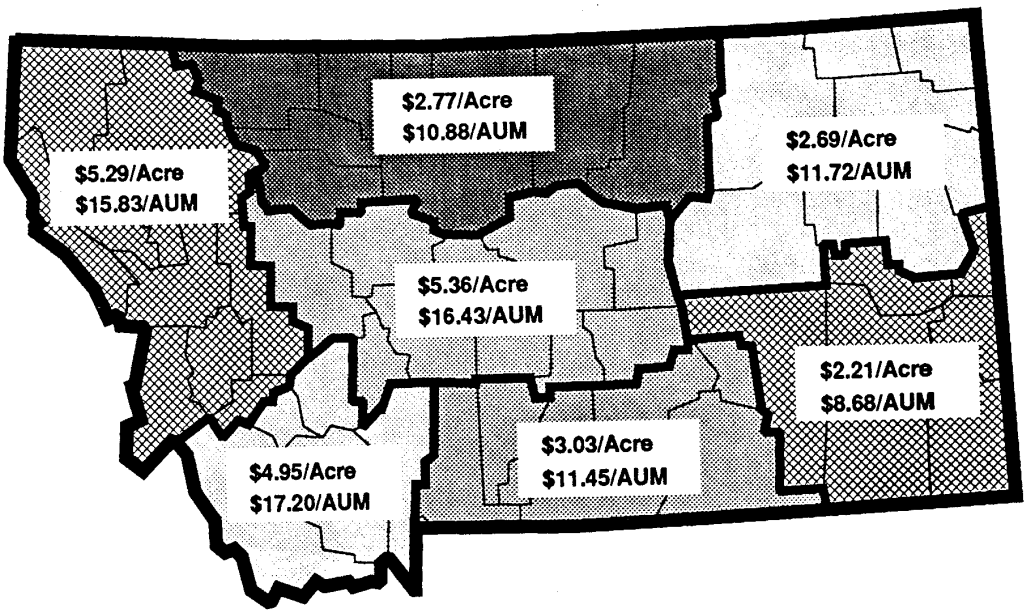
[c]Bureau of Land Management leased AUMs represent 1990 grazing season and were obtained from the Bureau of Land Management District Office, Cheyenne, Wyoming. United States Forest Service leased AUMs represent 1990 grazing season and were obtained from the United States Forest Service, Range Management Division, Washington, D.C.

APPENDIX D

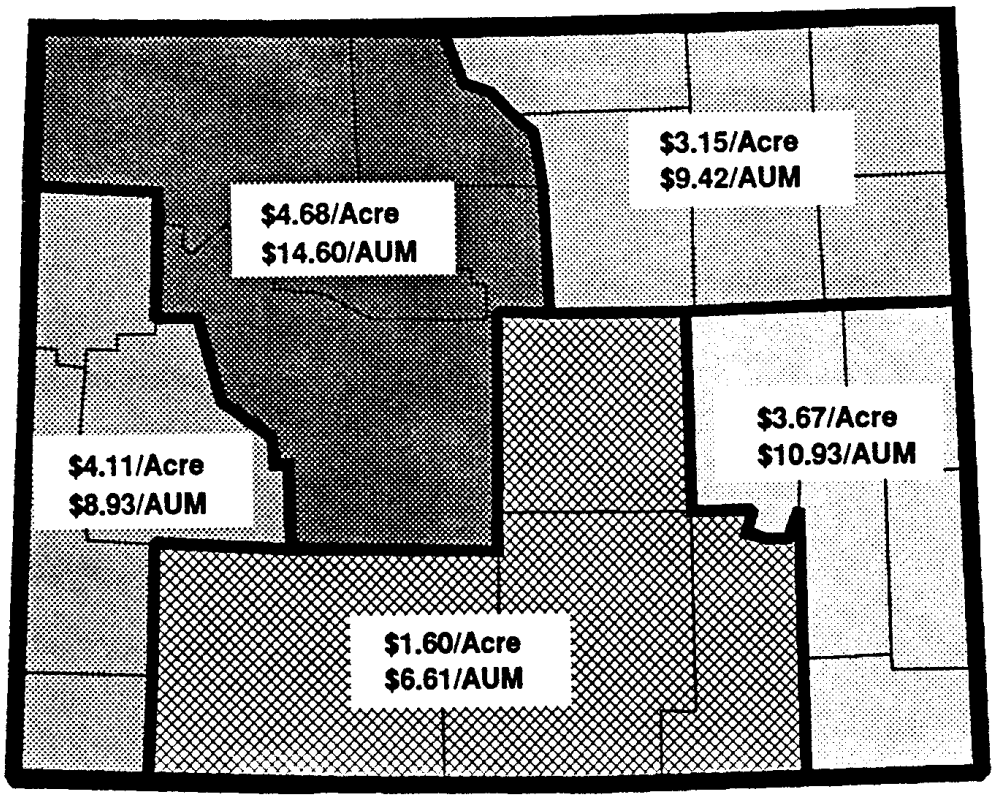
Cash Rent Per Acre and Value Per AUMS



Appendix Figure D1. Average Adjusted Cash Rent per Acre of Rangeland and Value per AUM in Montana, by Agricultural Statistics Districts, 1986-1990



Appendix Figure D2. Average Adjusted Cash Rent per Acre of Rangeland and Value per AUM in South Dakota, by Agricultural
Statistics Districts, 1986-1990



Appendix Figure D3. Average Adjusted Cash Rent per Acre of Rangeland and Value per AUM in Wyoming, by Agricultural Statistics Districts, 1986-1990

APPENDIX E

Economic Impacts Using Alternative AUM Values

This appendix explains the difference that state and federal rates for non-private AUMs have on direct and secondary impacts of leafy spurge infestations on grazing lands.

State and federal AUMs were valued at the rate charged to ranchers in an alternative measure of the economic impact of leafy spurge on grazing lands. Since the rates the state governments, USBLM, and the USFS charge for AUMs are lower than private values, the alternative impact represents a minimum estimate of the economic impacts of leafy spurge on grazing lands.

The USBLM and USFS in 1990 charged $1.81 per AUM in Montana, South Dakota, and Wyoming. Montana Department of State Lands charged $4.34, $4.24, and $4.14 per AUM in 1991. The number of AUMs in each rate class was obtained and used to calculate an average value per AUM. The average rate charged on state lands in Montana in 1991 was $4.19 per AUM. Rates charged in 1990 were not obtained. South Dakota Department of School and Public Lands charged different rates per acre for state grazing lands. The lease rate per acre by land tract and the number of AUMs grazed by lease were used to calculate a county-level average value per AUM. South Dakota had an average lease rate of $5.37 per AUM for state-leased grazing lands in 1990. The Wyoming State Land and Farm Loan office charged $2.50 per AUM grazed on state lands in 1990.

Three steps were used to estimate the value of lost grazing. First, the percent of AUMs generated on private, state, and federal grazing lands were determined by county. Second, the number of lost AUMs by county were allocated proportional to each category's percent of the total number of AUMs within the county. Third, the appropriate private, state, and federal values for AUMs were applied to the number of lost AUMs in each ownership category to estimate the total value of lost grazing (Appendix Table E1).

The direct impacts that changed with different AUM values were ranchers' incomes. Lost grazing capacity remained unchanged; therefore, the size of the cow-calf herds that could be grazed on the lost AUMs and the associated reduction in rancher expenses (i.e., business revenues for related businesses) did not change. Thus, rancher income was the only direct economic impact changed when different values were assigned to state and federal AUMs, under the same assumptions found in the main analysis.

Direct impacts of leafy spurge were about $5.4 million, $3.8 million, and $743,000 in Montana, South Dakota, and Wyoming, respectively, when non-private AUMs were valued at state and federal lease rates. South Dakota had the smallest drop in

direct impacts since state and federal AUMs comprise a smaller percent of total grazing capacity than those in Montana or Wyoming.

The North Dakota I-O Model was used to estimate the secondary impacts generated from the alternative level of direct impacts. Secondary impacts were $12.3 million, $8.7 million, and $1.7 million for Montana, South Dakota, and Wyoming, respectively.

APPENDIX TABLE E1. VALUE OF LOST GRAZING CAPACITY FROM LEAFY SPURGE INFESTATIONS IN MONTANA, SOUTH DAKOTA, AND WYOMING BASED ON PRIVATE, STATE, AND FEDERAL VALUES FOR AUMS BY AGRICULTURAL STATISTICS DISTRICTS, 1990

Agricultural Statistics Districts	Lost AUMs by Ownership Category			Value of Lost Grazing[a]
	Private	State	Federal	
				- dollars -
MONTANA				
Central	53,172	4,741	4,473	779,896
North Central	15,538	2,382	3,835	264,736
North East	13,007	1,040	1,940	181,117
North West	7,638	740	2,066	121,899
South Central	17,750	1,157	1,380	318,998
South East	6,428	453	1,179	62,899
South West	13,516	1,406	5,178	129,411
TOTAL	127,049	11,920	20,051	1,858,956
SOUTH DAKOTA				
Central	16,834	14	16	246,217
East Central	14,045	0	0	217,132
West Central	1,334	18	83	21,591
North Central	7,902	347	1	127,585
North East	32,537	187	0	466,852
North West	727	48	65	7,674
South Central	1,396	9	5	21,263
South East	20,482	0	4	314,071
South West	220	7	31	1,597
TOTAL	95,479	629	204	1,423,983
WYOMING				
North East	18,579	1,740	2,490	163,139
North West	732	52	223	11,939
South Central	166	19	73	794
South East	466	58	16	6,541
West	257	32	173	3,686
TOTAL	20,200	1,901	2,974	186,099

[a]The value of lost AUMs for each region was calculated by summing the values of lost AUMs for each county in the region.

Direct impacts from leafy spurge decreased about $327,000, $8,000, and $35,300 in Montana, South Dakota, and Wyoming, respectively, using alternative AUM values. Smaller direct impacts reduced secondary impacts by about $679,000, $15,000, and $74,000 for Montana, South Dakota, and Wyoming, respectively. Direct and secondary impacts were reduced by about $1.1 million in the three states when state and federal rates were assigned to non-private AUMs.

APPENDIX F

Cow-Calf Herd Characteristics and Assumptions

This appendix lists the herd characteristics and assumptions used in the cow-calf budgets; both those used to estimate alternative private values for AUMs and those used to estimate foregone production expenditures (i.e., business revenues used to estimate direct impacts). Herd characteristics and assumptions used for Montana and Wyoming differed from those used for South Dakota.

Due to lack of current information on owner-operator debt, cow-calf budgets for Montana, South Dakota, and Wyoming were generated assuming no debt. Replacement heifers were assumed to be raised, not purchased, in all three states.

Hughes et al. (1989) provided investment figures for land, equipment, and buildings for South Dakota and for estimating equipment and building investment for Montana and Wyoming. Land investment for Montana and Wyoming was estimated from acres of cropland, pasture, and rangeland provided by Kearl et al. (1986) and prices obtained from USDA-ERS survey information. Hughes et al. (1989) provided depreciation rates, repairs, taxes, and insurance on equipment, buildings, and land, along with investment per cow and heifer for the three states.

Grazing requirements represented a compromise between those of Kearl et al. (1986) and Hughes et al. (1989). Grazing requirements used for the three states were 1.1 AUMs per cow-calf unit, 0.9 AUMs per replacement heifer, and one AUM per bull.

Selling prices for steers, heifers, cull bulls, cull cows, and cull heifers, along with feed costs, livestock expenses, and all miscellaneous costs, were provided or determined from the budget generator.

Montana-Wyoming
Cow-Calf Herd Characteristics

The following herd characteristics were obtained from Kearl et al. (1986).

91.7% calf crop	15.2% replacement rate
1.7% cow loss	21 cows per bull
3.9 years useful bull life	210 days grazing period
Steer calves sold at 464 lbs.	Heifer calves sold at 430 lbs.
Cull cows sold at 985 lbs.	Cull heifers sold at 780 lbs.
Cull bulls sold at 1547 lbs.	

South Dakota
Cow-Calf Herd Characteristics

The following herd characteristics were obtained from Hughes et al. (1989).

90.0% calf crop	15.0% replacement rate
1.0% cow loss	23.5 cows per bull
3.0 years useful bull life	210 days grazing period
Steer calves sold at 528 lbs.	Heifer calves sold at 499 lbs.
Cull cows sold at 900 lbs.	Cull heifers sold at 875 lbs.
Cull bulls sold at 1700 lbs.	

The budget information that follows was extracted from the budget generator developed by Hughes et al. (1989).

Beef Cow-Calf Production Budgets for Montana-Wyoming
Budgets Used in AUM Valuation -- 260-COW HERD

RECEIPTS

	-- Hd --			
Steers	114	464 lbs.	$0.97/lb	= $51,309
Heifers	71	430 lbs.	$0.91/lb	= $27,782
Cull Cows	35	985 lbs.	$0.49/lb	= $16,893
Cull Heifers	8	780 lbs.	$0.60/lb	= $3,744
Cull Bull	4	1,547 lbs.	$0.53/lb	= $3,280
			Total Income Per Herd	= $103,008
			Total Income Per Cow	= $396

FEED EXPENSES

				Opportunity Costs
210 Days of Summer Grazing				
260 Cows @ 1.1 AUMs =	2002 AUMs	@ $10.00/AUM	=	$20,020
51 R Hfr @ 0.9 AUMs =	321 AUMs	@ $10.00/AUM	=	$3,213
15 Bulls @ 1.0 AUMs =	105 AUMs	@ $10.00/AUM	=	$1,050
Mineral and Salt	2.99 Tons	@ $400/Ton	=	$1,197
155 Days of Winter Feeding				
Oats	410.0 Bushels	$1.65/Bu	=	$677
Protein	7.6 Tons	$189.00/Ton	=	$1,436
Hay	542.6 Tons	$50.00/Ton	=	$27,131
Mineral and Salt	2.2 Tons	$400.00/Ton	=	$883
		Total Feed Costs Per Herd	=	$55,604
		Total Feed Costs Per Cow	=	$214

LIVESTOCK EXPENSES

		Rate Per Hd	Opportunity Costs
Veterinary and Medicine		$6.00/Cow	= $1,560
Fly Tags		$4.00/Cow	= $1,040
Bull Semen Check		$20.00/Bull	= $300
Utilities and General Farm		$7.00/Cow	= $1,820
Power and Fuel		$8.00/Cow	= $2,080
Bedding		$2.00/Cow	= $520
Marketing		$6.50/Cow	= $1,690
Miscellaneous		$7.00/Cow	= $1,820
Bull Insurance	(Estimated at 1% of Total Bull Value)		= $263
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)		= $4,002

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use		=	$3,577
Total Livestock Expenses Per Herd		=	$18,672
Total Livestock Expenses Per Cow		=	$72

Beef Cow-Calf Production Budgets for Montana-Wyoming
Budgets Used in AUM Valuation -- 260-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$460,000	1%	=	xxxxxx
Buildings	$15,000	7%	=	$1,050
Equipment	$35,000	12%	=	$4,200
Investment per Cow	$800	1%	=	$2,080
Investment per Heifer	$700	1%	=	$357
Bull Investment	$26,250	1%	=	xxxxxx
Total Fixed Costs Per Herd			=	$7,687
Total Fixed Costs Per Cow			=	$30

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$103,008
Less Feed and Livestock Expenses	$74,276
Returns Above Variable Costs	$28,732
Less Fixed Expenses	$7,687
Returns to Labor, Management, & Equity Capital for the Herd	$21,045
Total Receipts Per Cow	$396
Less Total Expenses Per Cow	$315
Returns to Labor, Management, & Equity Capital Per Cow	$81

Beef Cow-Calf Production Budgets for Montana-Wyoming
Budgets Used in AUM Valuation -- 179-COW HERD

RECEIPTS

	-- Hd --			
Steers	82	464 lbs.	$0.97/lb	= $36,907
Heifers	47	430 lbs.	$0.91/lb	= $18,391
Cull Cows	24	985 lbs.	$0.49/lb	= $11,584
Cull Heifers	6	780 lbs.	$0.60/lb	= $2,808
Cull Bull	3	1,547 lbs.	$0.53/lb	= $2,050
			Total Income Per Herd	= $71,739
			Total Income Per Cow	= $401

FEED EXPENSES

				Opportunity Costs
210 Days of Summer Grazing				
179 Cows @ 1.1 AUMs =	1378 AUMs	@ $10.00/AUM	=	$13,780
51 R Hfr @ 0.9 AUMs =	221 AUMs	@ $10.00/AUM	=	$2,210
10 Bulls @ 1.0 AUMs =	70 AUMs	@ $10.00/AUM	=	$700
Mineral and Salt	2.06 Tons	@ $400/Ton	=	$824
155 Days of Winter Feeding				
Oats	282.0 Bushels	$1.65/Bu	=	$465
Protein	4.6 Tons	$189.00/Ton	=	$869
Hay	372.8 Tons	$50.00/Ton	=	$18,640
Mineral and Salt	1.5 Tons	$400.00/Ton	=	$608
		Total Feed Costs Per Herd	=	$38,097
		Total Feed Costs Per Cow	=	$213

LIVESTOCK EXPENSES

		Rate Per Hd	Opportunity Costs
Veterinary and Medicine		$6.00/Cow	= $1,074
Fly Tags		$4.00/Cow	= $716
Bull Semen Check		$20.00/Bull	= $200
Utilities and General Farm		$7.00/Cow	= $1,253
Power and Fuel		$8.00/Cow	= $1,432
Bedding		$2.00/Cow	= $358
Marketing		$6.50/Cow	= $1,164
Miscellaneous		$7.00/Cow	= $1,253
Bull Insurance	(Estimated at 1% of Total Bull Value)		= $175
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)		= $2,743

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use		=	$2,385
Total Livestock Expenses Per Herd		=	$12,753
Total Livestock Expenses Per Cow		=	$71

Beef Cow-Calf Production Budgets for Montana-Wyoming
Budgets Used in AUM Valuation -- 179-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$460,000	1%	=	xxxxxx
Buildings	$15,000	7%	=	$1,050
Equipment	$35,000	12%	=	$4,200
Investment per Cow	$800	1%	=	$1,432
Investment per Heifer	$700	1%	=	$245
Bull Investment	$17,500	1%	=	xxxxxx
Total Fixed Costs Per Herd			=	$6,927
Total Fixed Costs Per Cow			=	$39

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$71,739
Less Feed and Livestock Expenses	$50,849
Returns Above Variable Costs	$20,890
Less Fixed Expenses	$6,927
Returns to Labor, Management, & Equity Capital for the Herd	$13,963
Total Receipts Per Cow	$401
Less Total Expenses Per Cow	$323
Returns to Labor, Management, & Equity Capital Per Cow	$78

Beef Cow-Calf Production Budgets for Montana-Wyoming
Budgets Used in AUM Valuation -- 97-COW HERD

RECEIPTS

	-- Hd --				
Steers	44	464 lbs.	$0.97/lb	=	$19,804
Heifers	25	430 lbs.	$0.91/lb	=	$9,783
Cull Cows	13	985 lbs.	$0.49/lb	=	$6,274
Cull Heifers	4	780 lbs.	$0.60/lb	=	$1,872
Cull Bull	2	1,547 lbs.	$0.53/lb	=	$1,230
			Total Income Per Herd	=	$38,962
			Total Income Per Cow	=	$402

FEED EXPENSES

				Opportunity Costs
210 Days of Summer Grazing				
97 Cows @ 1.1 AUMs =	748 AUMs	@ $10.00/AUM	=	$7,480
19 R Hfr @ 0.9 AUMs =	120 AUMs	@ $10.00/AUM	=	$1,200
6 Bulls @ 1.0 AUMs =	42 AUMs	@ $10.00/AUM	=	$420
Mineral and Salt	1.12 Tons	@ $400/Ton	=	$447
155 Days of Winter Feeding				
Oats	153.5 Bushels	$1.65/Bu	=	$253
Protein	2.5 Tons	$189.00/Ton	=	$469
Hay	201.6 Tons	$50.00/Ton	=	$10,082
Mineral and Salt	0.8 Tons	$400.00/Ton	=	$330
		Total Feed Costs Per Herd	=	$20,680
		Total Feed Costs Per Cow	=	$213

LIVESTOCK EXPENSES

		Rate Per Hd		Opportunity Costs
Veterinary and Medicine		$6.00/Cow	=	$582
Fly Tags		$4.00/Cow	=	$388
Bull Semen Check		$20.00/Bull	=	$120
Utilities and General Farm		$7.00/Cow	=	$679
Power and Fuel		$8.00/Cow	=	$776
Bedding		$2.00/Cow	=	$194
Marketing		$6.50/Cow	=	$631
Miscellaneous		$7.00/Cow	=	$679
Bull Insurance	(Estimated at 1% of Total Bull Value)		=	$105
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)		=	$1,490

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use		=	$1,431
Total Livestock Expenses Per Herd		=	$7,074
Total Livestock Expenses Per Cow		=	$73

Beef Cow-Calf Production Budgets for Montana-Wyoming
Budgets Used in AUM Valuation -- 97-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$460,000	1%	=	xxxxxx
Buildings	$15,000	7%	=	$1,050
Equipment	$35,000	12%	=	$4,200
Investment per Cow	$800	1%	=	$776
Investment per Heifer	$700	1%	=	$133
Bull Investment	$10,500	1%	=	xxxxxx
Total Fixed Costs Per Herd			=	$6,159
Total Fixed Costs Per Cow			=	$63

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$38,962
Less Feed and Livestock Expenses	$27,754
Returns Above Variable Costs	$11,208
Less Fixed Expenses	$6,159
Returns to Labor, Management, & Equity Capital for the Herd	$5,049
Total Receipts Per Cow	$402
Less Total Expenses Per Cow	$350
Returns to Labor, Management, & Equity Capital Per Cow	$52

Beef Cow-Calf Production Budgets for South Dakota
Budgets Used in AUM Valuation -- 100-COW HERD

RECEIPTS

	-- Hd --				
Steers	45	528 lbs.	$0.97/lb	=	$23,047
Heifers	26	499 lbs.	$0.91/lb	=	$11,806
Cull Cows	14	900 lbs.	$0.49/lb	=	$6,174
Cull Heifers	4	875 lbs.	$0.60/lb	=	$2,100
Cull Bull	1	1,700 lbs.	$0.53/lb	=	$901
			Total Income Per Herd	=	$44,029
			Total Income Per Cow	=	$440

FEED EXPENSES

					Opportunity Costs
210 Days of Summer Grazing					
100 Cows @ 1.1 AUMs =	770 AUMs	@	$10.00/AUM	=	$7,700
19 R Hfr @ 0.9 AUMs =	120 AUMs	@	$10.00/AUM	=	$1,200
5 Bulls @ 1.0 AUMs =	35 AUMs	@	$10.00/AUM	=	$350
Mineral and Salt	1.15 Tons	@	$400/Ton	=	$460
155 Days of Winter Feeding					
Oats	218.0 Bushels		$1.65/Bu	=	$360
Protein	2.5 Tons		$189.00/Ton	=	$473
Hay	250.0 Tons		$50.00/Ton	=	$12,500
Mineral and Salt	0.85 Tons		$400.00/Ton	=	$340
			Total Feed Costs Per Herd	=	$23,382
			Total Feed Costs Per Cow	=	$234

LIVESTOCK EXPENSES

		Rate Per Hd		Opportunity Costs
Veterinary and Medicine		$6.00/Cow	=	$600
Fly Tags		$4.00/Cow	=	$400
Bull Semen Check		$20.00/Bull	=	$100
Utilities and General Farm		$7.00/Cow	=	$700
Power and Fuel		$8.00/Cow	=	$800
Bedding		$2.00/Cow	=	$200
Marketing		$6.50/Cow	=	$650
Miscellaneous		$7.00/Cow	=	$700
Bull Insurance	(Estimated at 1% of Total Bull Value)		=	$88
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)		=	$1,657

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use		=	$1,415
Total Livestock Expenses Per Herd		=	$7,310
Total Livestock Expenses Per Cow		=	$73

Beef Cow-Calf Production Budgets for South Dakota
Budgets Used in AUM Valuation -- 100-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$150,000	1%	=	xxxxxx
Buildings	$12,500	7%	=	$875
Equipment	$20,000	12%	=	$2,400
Investment per Cow	$800	1%	=	$800
Investment per Heifer	$700	1%	=	$133
Bull Investment	$8,750	1%	=	xxxxxx
Total Fixed Costs Per Herd			=	$4,208
Total Fixed Costs Per Cow			=	$42

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$44,029
Less Feed and Livestock Expenses	$30,692
Returns Above Variable Costs	$13,337
Less Fixed Expenses	$4,208
Returns to Labor, Management, & Equity Capital for the Herd	$9,129
Total Receipts Per Cow	$440
Less Total Expenses Per Cow	$349
Returns to Labor, Management, & Equity Capital Per Cow	$91

Beef Cow-Calf Production Budgets for South Dakota
Budgets Used in AUM Valuation -- 68-COW HERD

RECEIPTS

	-- Hd --				
Steers	31	528 lbs.	$0.97/lb	=	$15,877
Heifers	18	499 lbs.	$0.91/lb	=	$8,174
Cull Cows	10	900 lbs.	$0.49/lb	=	$4,410
Cull Heifers	2	875 lbs.	$0.60/lb	=	$1,050
Cull Bull	1	1,700 lbs.	$0.53/lb	=	$1,198
			Total Income Per Herd	=	$30,709
			Total Income Per Cow	=	$452

FEED EXPENSES

				Opportunity Costs
210 Days of Summer Grazing				
68 Cows @ 1.1 AUMs =	525 AUMs	@ $10.00/AUM	=	$5,250
13 R Hfr @ 0.9 AUMs =	83 AUMs	@ $10.00/AUM	=	$830
4 Bulls @ 1.0 AUMs =	28 AUMs	@ $10.00/AUM	=	$280
Mineral and Salt	0.78 Tons	@ $400/Ton	=	$313
155 Days of Winter Feeding				
Oats	148.0 Bushels	$1.65/Bu	=	$244
Protein	1.7 Tons	$189.00/Ton	=	$321
Hay	170.0 Tons	$50.00/Ton	=	$8,500
Mineral and Salt	0.57 Tons	$400.00/Ton	=	$231
		Total Feed Costs Per Herd	=	$15,970
		Total Feed Costs Per Cow	=	$235

LIVESTOCK EXPENSES

		Rate Per Hd		Opportunity Costs
Veterinary and Medicine		$6.00/Cow	=	$408
Fly Tags		$4.00/Cow	=	$272
Bull Semen Check		$20.00/Bull	=	$80
Utilities and General Farm		$7.00/Cow	=	$476
Power and Fuel		$8.00/Cow	=	$544
Bedding		$2.00/Cow	=	$136
Marketing		$6.50/Cow	=	$442
Miscellaneous		$7.00/Cow	=	$476
Bull Insurance	(Estimated at 1% of Total Bull Value)		=	$70
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)		=	$1,132

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use		=	$1,132
Total Livestock Expenses Per Herd		=	$5,168
Total Livestock Expenses Per Cow		=	$76

Beef Cow-Calf Production Budgets for South Dakota
Budgets Used in AUM Valuation -- 68-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$150,000	1%	=	xxxxxx
Buildings	$12,500	7%	=	$875
Equipment	$20,000	12%	=	$2,400
Investment per Cow	$800	1%	=	$544
Investment per Heifer	$700	1%	=	$91
Bull Investment	$7,000	1%	=	xxxxxx
Total Fixed Costs Per Herd			=	$3,910
Total Fixed Costs Per Cow			=	$58

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$30,709
Less Feed and Livestock Expenses	$21,138
Returns Above Variable Costs	$9,571
Less Fixed Expenses	$3 910
Returns to Labor, Management, & Equity Capital for the Herd	$5,661
Total Receipts Per Cow	$452
Less Total Expenses Per Cow	$368
Returns to Labor, Management, & Equity Capital Per Cow	$84

Beef Cow-Calf Production Budgets for South Dakota
Budgets Used in AUM Valuation -- 37-COW HERD

RECEIPTS

		-- Hd --			
Steers	17	528 lbs.	$0.97/lb	=	$8,707
Heifers	10	499 lbs.	$0.91/lb	=	$4,541
Cull Cows	5	900 lbs.	$0.49/lb	=	$2,205
Cull Heifers	2	875 lbs.	$0.60/lb	=	$1,050
Cull Bull	1	1,700 lbs.	$0.53/lb	=	$901
			Total Income Per Herd	=	$17,404
			Total Income Per Cow	=	$470

FEED EXPENSES

					Opportunity Costs
210 Days of Summer Grazing					
37 Cows @ 1.1 AUMs =	283 AUMs	@	$10.00/AUM	=	$2,830
7 R Hfr @ 0.9 AUMs =	43 AUMs	@	$10.00/AUM	=	$430
3 Bulls @ 1.0 AUMs =	21 AUMs	@	$10.00/AUM	=	$210
Mineral and Salt	0.43 Tons	@	$400/Ton	=	$170
155 Days of Winter Feeding					
Oats	82.0 Bushels		$1.65/Bu	=	$135
Protein	1.1 Tons		$189.00/Ton	=	$208
Hay	93.2 Tons		$50.00/Ton	=	$4,660
Mineral and Salt	0.31 Tons		$400.00/Ton	=	$126
			Total Feed Costs Per Herd	=	$8,769
			Total Feed Costs Per Cow	=	$237

LIVESTOCK EXPENSES

		Rate Per Hd		Opportunity Costs
Veterinary and Medicine		$6.00/Cow	=	$222
Fly Tags		$4.00/Cow	=	$148
Bull Semen Check		$20.00/Bull	=	$60
Utilities and General Farm		$7.00/Cow	=	$259
Power and Fuel		$8.00/Cow	=	$296
Bedding		$2.00/Cow	=	$74
Marketing		$6.50/Cow	=	$241
Miscellaneous		$7.00/Cow	=	$259
Bull Insurance	(Estimated at 1% of Total Bull Value)		=	$53
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)		=	$849

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use		=	$623
Total Livestock Expenses Per Herd		=	$3,083
Total Livestock Expenses Per Cow		=	$83

Beef Cow-Calf Production Budgets for South Dakota
Budgets Used in AUM Valuation -- 37-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$150,000	1%	=	xxxxxx
Buildings	$12,500	7%	=	$875
Equipment	$20,000	12%	=	$2,400
Investment per Cow	$800	1%	=	$296
Investment per Heifer	$700	1%	=	$49
Bull Investment	$5,250	1%	=	xxxxxx
Total Fixed Costs Per Herd			=	$3,620
Total Fixed Costs Per Cow			=	$98

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$17,404
Less Feed and Livestock Expenses	$11,852
Returns Above Variable Costs	$5,552
Less Fixed Expenses	$3,620
Returns to Labor, Management, & Equity Capital for the Herd	$1,932
Total Receipts Per Cow	$470
Less Total Expenses Per Cow	$418
Returns to Labor, Management, & Equity Capital Per Cow	$52

APPENDIX G

Cow-Calf Budgets Used to Estimate Expenditure Reductions

Beef Cow-Calf Production Budgets for Montana
Estimation of Direct Impacts -- 17,032-COW HERD

RECEIPTS

	-- Hd --				
Steers	7,809	464 lbs.	$0.97/lb	=	$3,514,675
Heifers	4,463	430 lbs.	$0.91/lb	=	$1,746,372
Cull Cows	2,265	985 lbs.	$0.49/lb	=	$1,093,202
Cull Heifers	791	780 lbs.	$0.60/lb	=	$370,188
Cull Bull	249	1,547 lbs.	$0.53/lb	=	$204,158
			Total Income Per Herd	=	$6,928,594
			Total Income Per Cow	=	$407

FEED EXPENSES

				Opportunity Costs
210 Days of Summer Grazing				
17032 Cows @	1.1 AUMs =	131,146 AUMs @	$10.00/AUM =	$1,311,462
3346 R Hfr @	0.9 AUMs =	21,080 AUMs @	$10.00/AUM =	$210,800
970 Bulls @	1.0 AUMs =	6,790 AUMs @	$10.00/AUM =	$67,900
Mineral and Salt		196.00 Tons @	$400/Ton =	$78,402
155 Days of Winter Feeding				
Oats		26,911.0 Bushels	$1.65/Bu =	$44,403
Protein		457.0 Tons	$189.00/Ton =	$86,373
Hay		35,512.0 Tons	$50.00/Ton =	$1,775,600
Mineral and Salt		145.0 Tons	$400.00/Ton =	$57,868
			Total Feed Costs Per Herd =	$3,632,808
			Total Feed Costs Per Cow =	$213

LIVESTOCK EXPENSES

		Rate Per Hd		Opportunity Costs
Veterinary and Medicine		$6.00/Cow	=	$102,192
Fly Tags		$4.00/Cow	=	$68,128
Bull Semen Check		$20.00/Bull	=	$19,400
Utilities and General Farm		$7.00/Cow	=	$119,224
Power and Fuel		$8.00/Cow	=	$136,256
Bedding		$2.00/Cow	=	$34,064
Marketing		$6.50/Cow	=	$110,708
Miscellaneous		$7.00/Cow	=	$119,224
Bull Insurance	(Estimated at 1% of Total Bull Value)		=	$16,975
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)		=	$261,539

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use	=	$231,330

Total Livestock Expenses Per Herd	=	$1,219,040
Total Livestock Expenses Per Cow	=	$72

Beef Cow-Calf Production Budgets for Montana
Estimation of Direct Impacts -- 17,032-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$30,195,771	1%	=	xxxxxx
Buildings	$982,615	7%	=	$68,783
Equipment	$2,292,769	12%	=	$275,132
Investment per Cow	$800	1%	=	$136,256
Investment per Heifer	$700	1%	=	$23,422
Bull Investment	$1,697,500	1%	=	xxxxxx

Total Fixed Costs Per Herd	=	$503,593
Total Fixed Costs Per Cow	=	$30

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

Insurance for cow herd was extracted from fixed costs. Since insurance rates vary by herd value, cow herd insurance was considered a variable cost that changes with the number of cows. Cow herd insurance was calculated with the following formula ((Number of cows x Investment per cow)/100 x $0.50).

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$6,928,594
Less Feed and Livestock Expenses	$4,851,848
Returns Above Variable Costs	$2,076,747
Less Fixed Expenses	$503,593
Returns to Labor, Management, & Equity Capital for the Herd	$1,573,153

Total Receipts Per Cow	$407
Less Total Expenses Per Cow	$314
Returns to Labor, Management, & Equity Capital Per Cow	$93

Beef Cow-Calf Production Budgets for South Dakota
Estimation of Direct Impacts -- 10,424-COW HERD

RECEIPTS

	-- Hd --				
Steers	4,691	528 lbs.	$0.97/lb	=	$2,402,543
Heifers	2,729	499 lbs.	$0.91/lb	=	$1,239,212
Cull Cows	1,459	900 lbs.	$0.49/lb	=	$643,419
Cull Heifers	399	875 lbs.	$0.60/lb	=	$209,475
Cull Bull	176	1,700 lbs.	$0.53/lb	=	$158,576
			Total Income Per Herd	=	$4,653,224
			Total Income Per Cow	=	$446

FEED EXPENSES

				Opportunity Costs
210 Days of Summer Grazing				
10424 Cows @ 1.1 AUMs =	80,265 AUMs	@ $10.00/AUM	=	$802,648
1962 R Hfr @ 0.9 AUMs =	12,361 AUMs	@ $10.00/AUM	=	$123,606
527 Bulls @ 1.0 AUMs =	3,689 AUMs	@ $10.00/AUM	=	$36,890
Mineral and Salt	119.96 Tons	@ $400/Ton	=	$47,984
155 Days of Winter Feeding				
Oats	22,724.3 Bushels	$1.65/Bu	=	$37,495
Protein	260.6 Tons	$189.00/Ton	=	$49,253
Hay	26,060.0 Tons	$50.00/Ton	=	$1,303,000
Mineral and Salt	88.5 Tons	$400.00/Ton	=	$35,417
		Total Feed Costs Per Herd	=	$2,436,293
		Total Feed Costs Per Cow	=	$214

LIVESTOCK EXPENSES

		Rate Per Hd		Opportunity Costs
Veterinary and Medicine		$6.00/Cow	=	$62,544
Fly Tags		$4.00/Cow	=	$41,696
Bull Semen Check		$20.00/Bull	=	$10,540
Utilities and General Farm		$7.00/Cow	=	$72,968
Power and Fuel		$8.00/Cow	=	$83,392
Bedding		$2.00/Cow	=	$20,848
Marketing		$6.50/Cow	=	$67,756
Miscellaneous		$7.00/Cow	=	$72,968
Bull Insurance	(Estimated at 1% of Total Bull Value)		=	$9,223
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)		=	$172,694

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use	=	$149,141
Total Livestock Expenses Per Herd	=	$763,769
Total Livestock Expenses Per Cow	=	$73

Beef Cow-Calf Production Budgets for South Dakota
Estimation of Direct Impacts -- 10,424-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$15,636,000	1%	=	xxxxxx
Buildings	$1,303,000	7%	=	$91,210
Equipment	$2,084,800	12%	=	$250,176
Investment per Cow	$800	1%	=	$83,392
Investment per Heifer	$700	1%	=	$13,734
Bull Investment	$922,250	1%	=	xxxxxx
Total Fixed Costs Per Herd			=	$438,512
Total Fixed Costs Per Cow			=	$42

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

Insurance for cow herd was extracted from fixed costs. Since insurance rates vary by herd value, cow herd insurance was considered a variable cost that changes with the number of cows. Cow herd insurance was calculated with the following formula ((Number of cows x Investment per cow)/100 x $0.50).

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$4,653,224
Less Feed and Livestock Expenses	$3,200,062
Returns Above Variable Costs	$1,453,162
Less Fixed Expenses	$438,512
Returns to Labor, Management, & Equity Capital for the Herd	$1,014,650

Total Receipts Per Cow	$446
Less Total Expenses Per Cow	$349
Returns to Labor, Management, & Equity Capital Per Cow	$97

Beef Cow-Calf Production Budgets for Wyoming
Estimation of Direct Impacts -- 2,685-COW HERD

RECEIPTS

	-- Hd --			
Steers	1,231	464 lbs.	$0.97/lb	= $554,048
Heifers	703	430 lbs.	$0.91/lb	= $275,084
Cull Cows	357	985 lbs.	$0.49/lb	= $172,306
Cull Heifers	125	780 lbs.	$0.60/lb	= $58,500
Cull Bull	39	1,547 lbs.	$0.53/lb	= $31,976
		Total Income Per Herd		= $1,091,915
		Total Income Per Cow		= $407

FEED EXPENSES

			Opportunity Costs
210 Days of Summer Grazing			
2685 Cows @ 1.1 AUMs =	20,675 AUMs	@ $10.00/AUM =	$206,745
528 R Hfr @ 0.9 AUMs =	3,326 AUMs	@ $10.00/AUM =	$33,264
153 Bulls @ 1.0 AUMs =	1,071 AUMs	@ $10.00/AUM =	$10,710
Mineral and Salt	30.9 Tons	@ $400/Ton =	$12,360
155 Days of Winter Feeding			
Oats	4,242.4 Bushels	$1.65/Bu =	$7,000
Protein	72.0 Tons	$189.00/Ton =	$13,616
Hay	5,598.3 Tons	$50.00/Ton =	$279,915
Mineral and Salt	22.8 Tons	$400.00/Ton =	$9,123
	Total Feed Costs Per Herd	=	$572,732
	Total Feed Costs Per Cow	=	$213

LIVESTOCK EXPENSES

		Rate Per Hd	Opportunity Costs
Veterinary and Medicine		$6.00/Cow =	$16,110
Fly Tags		$4.00/Cow =	$10,740
Bull Semen Check		$20.00/Bull =	$3,060
Utilities and General Farm		$7.00/Cow =	$18,795
Power and Fuel		$8.00/Cow =	$21,480
Bedding		$2.00/Cow =	$5,370
Marketing		$6.50/Cow =	$17,453
Miscellaneous		$7.00/Cow =	$18,795
Bull Insurance	(Estimated at 1% of Total Bull Value)	=	$2,678
Interest Expense	(12% @ 6 mnths x Lvstck & Feed Exp)	=	$41,233

Bull Depreciation (Purchase Price - Salvage Value)/Years of Use	=	$36,488

Total Livestock Expenses Per Herd	=	$192,411
Total Livestock Expenses Per Cow	=	$72

Beef Cow-Calf Production Budgets for Wyoming
Estimation of Direct Impacts -- 2,685-COW HERD

FIXED EXPENSES

	Investment	Repairs Depreciation Insurance & Taxes		Opportunity Costs
Land	$4,760,195	1%	=	xxxxxx
Buildings	$154,904	7%	=	$10,843
Equipment	$361,442	12%	=	$43,373
Investment per Cow	$800	1%	=	$21,480
Investment per Heifer	$700	1%	=	$3,696
Bull Investment	$267,750	1%	=	xxxxxx

Total Fixed Costs Per Herd	=	$79,392
Total Fixed Costs Per Cow	=	$30

Opportunity costs for land investment and bull investment were only recognized in the budget generator in the "cash flow" portion of the budget.

Insurance for cow herd was extracted from fixed costs. Since insurance rates vary by herd value, cow herd insurance was considered a variable cost that changes with the number of cows. Cow herd insurance was calculated with the following formula ((Number of cows x Investment per cow)/100 x $0.50).

COSTS/RETURNS SUMMARY

	Opportunity Costs
Receipts	$1,091,915
Less Feed and Livestock Expenses	$765,142
Returns Above Variable Costs	$326,773
Less Fixed Expenses	$79,392
Returns to Labor, Management, & Equity Capital for the Herd	$247,380

Total Receipts Per Cow	$407
Less Total Expenses Per Cow	$315
Returns to Labor, Management, & Equity Capital Per Cow	$92