

# **Ranch Operators' Perceptions of Leafy Spurge**

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## ABSTRACT

A survey of 459 ranchers was conducted to evaluate managerial, institutional, and social factors that may affect the rate and extent of implementation of various leafy spurge (*Euphorbia esula* L.) controls in a five-county region in Montana, North Dakota, South Dakota, and Wyoming. Ranchers returned 187 questionnaires.

Weeds were considered a greater problem for ranchers with leafy spurge than for those without leafy spurge; however, even among ranchers with leafy spurge, there was strong agreement that other ranching issues were of greater concern. Over 65 percent of the respondents indicated that weeds on their ranch were a 'minor problem.' Leafy spurge was ranked as the most important weed.

Nearly 60 percent of ranchers felt that using herbicides, biological agents, and grazing animals on leafy spurge were economical; however, only 25 percent of ranchers with leafy spurge felt those controls were 'very effective.' A majority of ranchers with leafy spurge indicated plans to treat their infestations with herbicides and biological agents in the future.

Reasons for not using various leafy spurge controls fell into environmental, educational, and financial categories. Ranchers depend heavily on their county extension agents and local weed control officers for information on weed control. Information on the effectiveness and economics of various controls was most requested by ranchers.

The responses of ranchers to various statements on weed and range management indicated that ranchers, as a group, are generally very concerned about weeds in rangeland. Respondents generally felt it makes economic sense to control weeds in rangeland, and felt very strongly that not enough was being done to control weeds on public land.

Ranchers realize the difficulty in controlling leafy spurge, but indicated they are still planning on fighting the weed in the future. Financial and educational constraints to adopting and using leafy spurge controls could be abated through university and governmental educational programs and through cost-share or other financial assistance.

Key Words: leafy spurge, control, rancher opinion.

## HIGHLIGHTS

Leafy spurge (*Euphorbia esula* L.) is an exotic, noxious, perennial weed which is widely established in the north central United States. It is estimated to infest 1.6 million acres in a four-state region including North and South Dakota, Montana, and Wyoming.

This study focused on a five-county area located in North Dakota (Billings and Golden Valley counties), Montana (Carter County), South Dakota (Harding County), and Wyoming (Crook County). A total of 459 ranch operators were surveyed, and 187 completed surveys were obtained (41 %). This sample was not a random sample, but represented those producers who have some type of grazing livestock. The questionnaire focused on weed management in general and specifically the attitudes and perceptions of producers who have been directly and indirectly impacted by leafy spurge.

Acreage of leafy spurge reported by respondents averaged less than 3 percent of acreage operated. North Dakota had the greatest percentage of respondents with leafy spurge; however, Wyoming had the highest rate of leafy spurge infestation. Invasive weeds and regulations affecting use of public lands were more of a problem to those producers who had leafy spurge than those who did not have leafy spurge. However, probably most revealing was that only 10 percent of those producers who currently have leafy spurge thought it was their most important problem (instead, livestock prices, adverse weather conditions, and availability of grazing land were more important problems than leafy spurge).

Two factors pose a concern about the future spread of leafy spurge: (1) most respondents indicated that they believe it is spread from adjoining land and (2) it is not recognized as a problem until too late. These factors, combined with the fact that only about one-quarter of those respondents who do not currently have leafy spurge believe that leafy spurge is their most important invasive weed, could pose a concern. Furthermore, more than 75 percent of ranchers with leafy spurge felt that control with herbicides was economical; however, more than 50 percent of ranchers with leafy spurge also indicated that infestations were inaccessible to sprayers. More than 50 percent of all respondents felt that environmental restrictions and too large of infestations were the main reasons for not using herbicide treatments. Nearly 50 percent of respondents thought that biological agents would 'take too long to work' to warrant trying to use them. Of those with leafy spurge, about one-third felt the agents would not work on their particular infestations. Twenty-nine percent of ranchers with leafy spurge felt grazing with sheep or goats would not provide effective control, and almost 75 percent of all respondents indicated not having the right type of equipment was the main barrier to using sheep and goats for control. The main reason (85 %) listed for not using methods other than chemical or biological treatments for controlling leafy spurge was that the land was not suitable for tillage. More than 50 percent of all respondents felt that tillage and/or reseeding would not be an effective means of controlling leafy spurge.

The most frequently used and most important source of information on weed management was the Extension Service. Those respondents who currently had leafy spurge on their ranch thought the most important source of weed management information was their county weed board/officers, followed closely by the Extension Service. The most important type of

information wanted by respondents was the effectiveness of various herbicide treatment programs, and they wanted this information in a pamphlet or bulletin. Those producers who currently have leafy spurge also indicated that area demonstration plots showing the effectiveness of various controls would be valuable. Also, nearly 50 percent of the ranchers indicated they use a computer on their ranch and of these, about 60 percent would be very interested in computer decision aids.

Overall, nearly all ranchers were concerned about controlling weeds on rangeland, that rangeland weeds represent a problem to all ranchers, and that leafy spurge is a long-term management problem. Those ranchers who currently have leafy spurge on their ranch strongly agree that they are concerned about controlling weeds on rangeland, that rangeland weeds represent a problem to all ranchers, and that biological agents released to control leafy spurge are safe for crops and native plants. Further, respondents indicated that they would like to see State and Federal government agencies do more to control problem weeds on public grazing land. Most respondents were in disagreement with the statements that weed infestations had no effect on the market value of rangeland or that public land managers are doing a good job controlling weeds, regardless of whether or not the respondents currently have a leafy spurge infestation.

# RANCH OPERATORS' PERCEPTIONS OF LEAFY SPURGE

Randall S. Sell, Dean A. Bangsund, F. Larry Leistritz, and Dan Nudell <sup>1</sup>

## INTRODUCTION

Leafy spurge (*Euphorbia esula* L.) is an exotic, noxious, perennial weed which is widely established in the north central United States. It is estimated to infest 1.6 million acres in a four-state region including North and South Dakota, Montana, and Wyoming. North Dakota has the greatest acreage of leafy spurge with nearly 6 percent of its untilled land infested (Leitch et al. 1994). The estimated annual economic impact of leafy spurge infestations in the four-state area is about \$130 million (Leitch et al. 1994; Bangsund et al. 1993). Until recently, leafy spurge in the upper Midwest had been doubling in acreage every ten years (Bangsund and Leistritz 1997). It is clear that leafy spurge can create serious economic losses for land owners and ranchers.

Leafy spurge has unique physiological characteristics which make it difficult to control; it can rejuvenate itself from extensive root reserves and sustain itself against repeated attacks. While current herbicides are incapable of eradicating established infestations, expansion can be controlled with a combination of biological and chemical technologies (Messersmith 1989; Lym and Messersmith 1994; Lym and Zollinger 1995; Lym et al. 1997). Eradication of the plant is possible using mechanical tillage; however, this control method is limited by the type of land infested. It has become evident that prevention of initial infestations and controlling the expansion of existing patches is critical to slowing the advance of this formidable weed.

Cost effective control of leafy spurge on rangeland requires use of a combination of chemical and biological control mechanisms in an integrated pest management (IPM) framework. In 1997, a major IPM research and demonstration project (TEAM Leafy Spurge) was initiated to develop and integrate sustainable leafy spurge management methods and to transfer to land managers economically and ecologically proven technologies to manage leafy spurge. The survey, which forms the basis for this report, was initiated to evaluate managerial, institutional, and social factors that may affect the rate and extent of implementation of various control strategies.

## METHODS

This study revolves around a five county area in North Dakota (Billings and Golden Valley Counties), Montana (Carter County), South Dakota (Harding County), and Wyoming (Crook County) (Figure 1). Mailing addresses of 397 ranch operators in the site counties were obtained (Intertec Publishing 1997). This sample list was supplemented with the names of 62 individuals who had participated in sheep production workshops at the Hettinger Research

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<sup>1</sup> Sell and Bangsund are research scientists, and Leistritz is a professor at Department of Agricultural Economics, North Dakota State University, Fargo; Nudell is a research station scientist at the Hettinger Research and Extension Center, North Dakota State University.

Extension Center. This list should represent those producers in the respective counties who have some type of grazing livestock (i.e., would not include those producers who only had agricultural crops).

The individuals on the list were mailed the first questionnaire and cover letter (Appendix A) in January 1998; one follow up questionnaire and cover letter were mailed to nonrespondents. The overall response rate was 41 percent (187 completed surveys). Response rates by state ranged from 35 to 49 percent for South Dakota and Montana, respectively (Appendix Table B1). Because of the survey mailing system used, it was not possible to determine the number of questionnaires which were not returned due to incomplete or noncurrent addresses versus those who refused to participate.

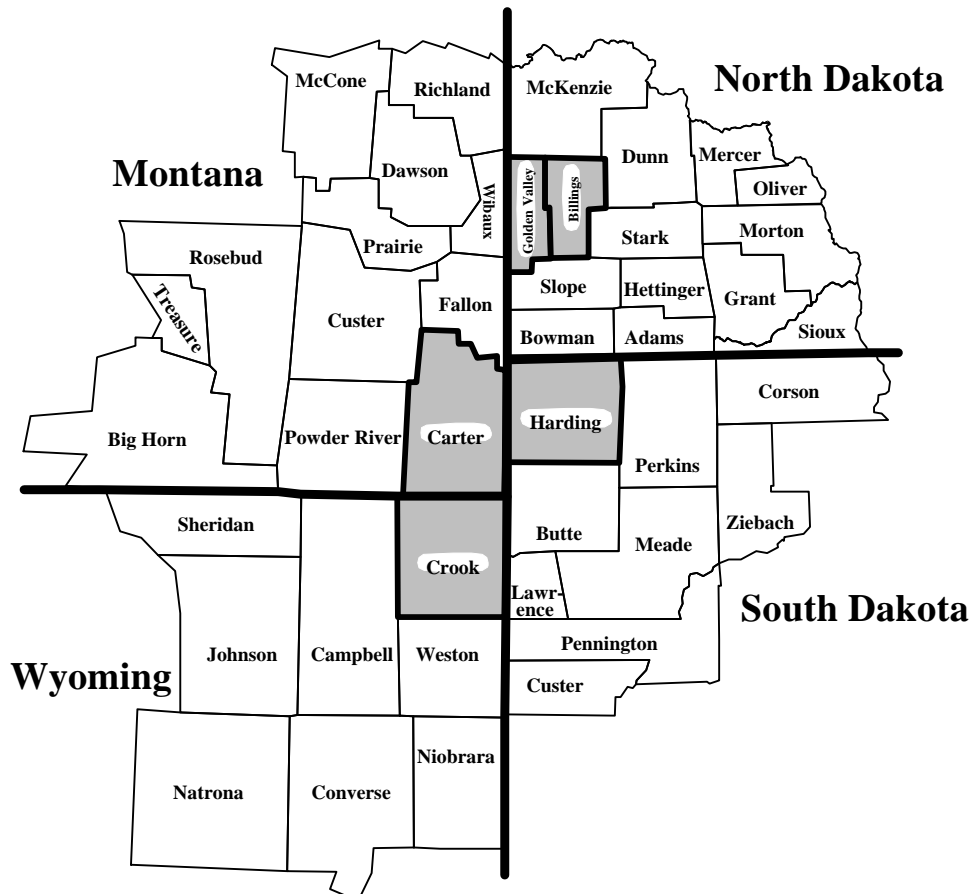


Figure 1. Study Counties, Rancher Perceptions of Leafy Spurge, 1998

The primary focus of the analysis of characteristics of the respondents and the respondents' ranches revolved around whether or not they currently had a leafy spurge infestation. Additional analyses are presented by state of residence.

## **RESULTS**

### Characteristics of Respondents

Respondents were relatively evenly distributed among the four states (Table 1). The largest share of the respondents were from Wyoming (29 %) and the smallest from Montana (19 %). The respondents' average age was 53, with nearly 50 percent older than 50 years. The average total acreage operated (calculated as total owned acreage plus total rented acreage minus acreage rented to others) was 6,912. About 21 percent of the respondents indicated that they operated more than 10,000 acres. For those 171 respondents (91 %) who indicated that they grazed cattle on their ranch, the average number of cattle grazed was 444 head. Fifty-three producers (28 %) indicated grazing sheep; their average was 1,175 head. Most of the sheep producers had both cattle and sheep on their ranches; only two sheep producers did not also have cattle. The average respondent derived 80 percent of their gross income from grazing animals, with nearly 50 percent obtaining more than 90 percent of their gross income from livestock grazing. Seventy-two percent of the respondents indicated using public rangeland. Over half of the producers (56 %) indicated that they currently had leafy spurge on their ranches. A comparison of the respondents by state revealed that North Dakota respondents operated less acreage, grazed fewer cattle, had a lower percentage of gross income from grazing, had the lowest percentage of ranchers using public rangeland, and had the greatest percentage of producers who had leafy spurge on their ranch (Appendix C).

A comparison of the respondent's size and scale of operation to Census data provided some insight into the relative differences and similarities of the population to the sample. Because of the type of sample drawn, a greater percentage of the producers in the survey had livestock and operated more acres than the Census average. Except for Billings County, acreage operated by respondents exceeded that reported as average farm size by the 1992 Census of Agriculture (Bureau of Census 1994) (Table 2). In Crook County, acreage operated by respondents was nearly three times the Census average. A comparison of the average number of cattle and sheep in inventory and animals grazed revealed that the survey group exceeds the Census average in all counties, except for sheep and lamb inventories in Billings County. Except Golden Valley County, about 75 to 80 percent of the ranches within the site counties have cattle on their ranches, making cattle the most prevalent type of livestock in the study area (according to both Census and survey respondents).

Table 1. Characteristics of Ranch Operators Responding to Weed Management Survey, 1998

Characteristic	Unit	Value
State:		
North Dakota	percent	27.7
Montana	“	18.5
South Dakota	“	25.0
Wyoming	“	28.8
Respondent Age:		
Mean	years	53
Distribution:		
less than 21	percent	1.1
21 to 25	“	1.1
26 to 30	“	2.1
31 to 40	“	12.8
41 to 50	“	34.8
51 to 60	“	19.8
61 to 65	“	9.6
more than 65	“	19.3
Total Acreage Operated:		
Mean	acres	6,912
Distribution:		
less than 2,001 acres	percent	24.6
2,001 to 4,000 acres	“	21.4
4,001 to 6,000 acres	“	15.5
6,001 to 10,000 acres	“	17.6
more than 10,000 acres	“	20.9
Livestock grazed: <sup>a</sup>		
Cows and calves (mean)	head	444
Distribution:		
1 to 100 head	percent	9.8
101 to 250 head	“	26.2
251 to 500 head	“	34.8
501 to 1000 head	“	23.2
more than 1,000 head	“	6.1
Sheep (mean)	head	1,175
Distribution:		
1 to 400 sheep	percent	34.0
401 to 1000 sheep	“	37.7
1,001 to 2,000 sheep	“	17.0
more than 2,000 sheep	“	11.3

- continued -

Table 1. Continued

Characteristic	Unit	Value
Horses (mean)	head	8
Distribution:		
1 to 3 horses	percent	23.1
4 to 10 horses	“	58.7
more than 10 horses	“	18.2
Education - highest level completed:		
Did not complete high school	“	7.1
High school graduate	“	49.2
Vocational/technical or 2-year college degree	“	18.6
Bachelor's Degree	“	20.8
Graduate school (Masters and/or Doctorate Degree)	“	4.4
Percentage Gross Income From Grazing Livestock Enterprise(s)		
Mean:	“	80.2
Distribution:		
50% or less	“	18.0
51 to 75%	“	13.5
76 to 90%	“	19.7
More than 90%	“	48.9
Percentage of Ranches Which Have Livestock Grazing Public Land	“	72.3
Net Income (1996):		
Negative	“	16.4
\$0 to \$5,000	“	15.2
\$5,001 to \$10,000	“	14.6
\$10,001 to \$20,000	“	18.7
\$20,001 to \$30,000	“	17.0
\$30,001 to \$40,000	“	7.0
\$40,001 to \$50,000	“	3.5
over \$50,000	“	7.6
Percentage of Respondents Who Worked Off-Farm in 1996	“	20.8
Currently Have Leafy Spurge on Ranch:		
Yes	“	55.6
No	“	44.4

<sup>a</sup> Nonexclusive categories (i.e., respondents may be grazing more than one species of livestock).

Table 2. Comparison of Survey Respondents to Census Statistics

Characteristic	Unit	Census	Sample	Ratio <sup>a</sup>
Average size of ranch: <sup>b</sup>				
Billings County, ND	acre	3,384	3,159	0.93
Golden Valley County, ND	“	2,308	3,518	1.52
Carter County, MT	“	5,258	7,597	1.44
Harding County, SD	“	5,877	7,740	1.32
Crook County, WY	“	3,489	9,695	2.78
Average inventory of livestock: <sup>c</sup>				
Billings County, ND	Cattle and calves	142	290	2.04
Golden Valley County, ND	“	165	239	1.45
Carter County, MT	“	218	484	2.22
Harding County, SD	“	299	495	1.66
Crook County, WY	“	214	529	2.47
Billings County, ND	Sheep and lambs	83	45	0.54
Golden Valley County, ND	“	174	602	3.46
Carter County, MT	“	756	855	1.13
Harding County, SD	“	611	1,539	2.52
Crook County, WY	“	475	1,210	2.55
Ranches with species of livestock: <sup>d</sup>				
		Cattle and calves		
Billings County, ND	Percent	80.2	88.9	
Golden Valley County, ND	“	59.4	93.8	
Carter County, MT	“	76.3	90.6	
Harding County, SD	“	78.4	91.1	
Crook County, WY	“	78.5	98.0	
		Sheep and lambs		
Billings County, ND	“	4.1	5.5	
Golden Valley County, ND	“	8.2	15.6	
Carter County, MT	“	40.6	34.4	
Harding County, SD	“	43.3	46.7	
Crook County, WY	“	19.7	28.0	

Source: Bureau of Census (1994).

<sup>a</sup> Ratio calculated as sample average/Census average.

<sup>b</sup> Average acreage in ranch composed of owned and rented acreage minus acreage rented to others.

<sup>c</sup> Census inventory of livestock was requested as of December 31, 1992, while sample respondents inventory is the average number of animals grazed.

<sup>d</sup> The percentage of ranches with cattle and calves and sheep and lambs was calculated from the number of ranches reporting an inventory of these animals divided by the total number of ranches reported for the respective counties.

## Problems Faced by Livestock Producers

A majority of producers (56 %) indicated they currently had a leafy spurge infestation. The greatest share (37 %) of producers who currently have leafy spurge on their ranch were in North Dakota (Table 3). South Dakota had the greatest share of producers who did not currently have leafy spurge on their ranch (35 %). North Dakota also had the highest percentage of respondents with leafy spurge on their ranch (72 %) and South Dakota the lowest (35 %). The acreage of leafy spurge as a percentage of total acreage operated was highest for Wyoming respondents. The average infestation in Wyoming was 3.6 percent of total acreage operated with a maximum of 49 percent. The lowest average infestation rate was 1 percent in South Dakota with a maximum of 6.4 percent. The leafy spurge infestation rates reported by respondents are comparable to previously released estimated leafy spurge infestation rates (Appendix C).

Respondents were asked about a series of grazing and weed management issues and asked to rate them as a *major* problem, *not* a problem, or a *minor* problem. Of the issues presented, most respondents (79 %) thought that livestock prices were a major problem (Table 4). This is not surprising given that cattle prices were in a down cycle from 1991 through 1996 and have only begun to rebound in the past 14 months (USDA 1998). A significant difference exists between those who indicated that they currently had leafy spurge and those who did not with respect to two issues; noxious and invasive weeds and regulations affecting use of public lands (in both instances a significantly greater share of those with leafy spurge indicated that these issues were a major problem). A comparison of the respondents by state revealed that a larger percentage of the Montana producers believed that adverse weather conditions and predators were a major problem than in any of the other states (Appendix Table B2). Alternatively, a greater share of the North Dakota respondents thought that regulations affecting use of public lands, noxious or invasive weeds, and use of CRP for haying or grazing were major problems.

When asked to indicate which of the issues listed was the single *most* important, livestock prices was again indicated as the most important problem (32 %). Less than 10 percent of all producers who currently had leafy spurge thought that noxious and invasive weeds were the most important problem. The greatest percentage of producers (67 %) indicated that livestock prices had become a more serious problem over the past five years than any other issue. Furthermore, more producers with leafy spurge felt that regulations affecting use of public land (61 %) had become a more serious problem than noxious weeds (52 %).

Table 3. Leafy Spurge Infestations by State, 1998

State of residence: *	Have leafy spurge:		Overall
	No	Yes	
	----- % -----		
North Dakota	17.7	36.7	28.3
Montana	24.1	15.3	19.2
South Dakota	35.4	15.3	24.3
Wyoming	<u>22.8</u>	<u>32.7</u>	<u>28.3</u>
Total	100.0	100.0	100.0

Leafy Spurge by State of residence:	No	Yes	Total
	----- % -----		
North Dakota	28.0	72.0	100.0
Montana	55.9	44.1	100.0
South Dakota	65.1	34.9	100.0
Wyoming	36.0	64.0	100.0

Leafy Spurge Infestation Rates (ranches operating more than 50 total acres)	- Avg. % -	- Min % -	- Max. % -	Ranchers reporting acreage of leafy spurge
North Dakota	2.2	0.0	10.4	28
Montana	2.3	0.0	17.0	13
South Dakota	0.9	0.0	6.4	12
Wyoming	3.6	0.0	49.3	30
Average overall	2.5	---	---	83

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't across states (Chi-square test statistic).

Table 4. Problems Faced by Ranchers and Changes in Problems in Past Five Years, 1998

Problems/Issues	Have leafy spurge:		Overall
	No	Yes	
	----- % indicated a <i>major</i> problem -----		
Livestock prices	82.3	76.5	79.1
Adverse weather conditions	65.4	61.6	63.3
Cost of feed and supplies	56.4	50.0	52.8
Predators	38.5	33.7	35.8
Regulations affecting use of public lands **	29.2	39.0	34.7
Noxious or invasive weeds *	11.5	44.9	30.1
Availability of grazing land	22.4	30.2	26.7
Use of CRP for haying and grazing	14.1	12.9	13.5
	----- % indicated <i>most</i> important problem -----		
Livestock prices	33.3	31.5	32.3
Adverse weather conditions	28.0	22.8	25.1
Cost of feed and supplies	12.0	7.6	9.6
Regulations affecting use of public lands	5.3	10.9	8.4
Availability of grazing land	2.7	12.0	7.8
Noxious or invasive weeds	5.3	8.7	7.2
Predators	8.0	3.3	5.4
Use of CRP for haying and grazing	2.7	0.0	1.2
	-- % indicated problem become worse in past 5 years --		
Livestock prices	65.8	68.0	67.1
Cost of feed and supplies	63.3	66.0	64.8
Regulations affecting use of public lands **	45.1	60.9	53.8
Predators	50.0	43.6	46.5
Noxious or invasive weeds *	28.6	52.0	41.7
Availability of grazing land *	23.7	46.9	36.6
Adverse weather conditions	25.3	26.5	26.0
Use of CRP for haying and grazing	7.9	10.5	9.4

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't for each individual problem (Chi-square test statistic).

\*\* Statistically different at  $P \leq 0.05$  between those who have leafy spurge and those who don't for each individual problem (Chi-square test statistic).

### Weed Species and Management Problems

Certainly weeds other than leafy spurge pose problems to livestock producers. Some of the other weeds which were specifically listed in the questionnaire included: field bindweed, thistles, annual brome grass, sagebrush, knapweeds, prickly pear, and absinth wormwood. The weed most often mentioned as a problem by the respondents was leafy spurge (49 %) followed by field bindweed (26 %) (Table 5). A greater share of those producers who did not have leafy spurge felt that field bindweed was more of a problem than leafy spurge. When asked to identify one weed which they felt posed the most serious problem, nearly 60 percent of respondents

indicated leafy spurge followed by thistles (12 %). A comparison of weed problems by state revealed that more North Dakota, Montana, and Wyoming producers believe leafy spurge and thistles are major problems than South Dakota producers (Appendix Table B3). Alternatively, a greater share of South Dakota producers think annual brome grass and prickly pear are major problem weeds.

Opinions varied on how invasive weeds spread in the area. Producers who indicated having leafy spurge on their land were much more likely to indicate that they felt invasive weeds spread from adjoining land than producers who did not have leafy spurge, 72 percent versus 53 percent, respectively (Table 6). Regardless, the most recognized cause of invasive weed problems was spreading from adjoining land followed by ‘not recognized as a threat until too late.’ When ranchers were asked to indicate how serious they felt weed problems were on their ranches, more than one-quarter (26 %) of those with leafy spurge felt it was a major problem while only 6 percent of those who did not currently have leafy spurge felt it was a major problem (Table 7).

Respondents were asked the extent to which they agreed or disagreed with a variety of statements about weed management, public land management, government agencies’ effect on land management, and leafy spurge management options. The statement with which the respondents most strongly agreed (average score closest to 5 - strongly agree) was ‘I am concerned about controlling weeds in rangeland’ (overall average score 4.8) (Table 8). Ranchers who currently have leafy spurge on their ranch indicated even stronger agreement with that statement (average score was 4.9). Ranchers with leafy spurge were also more likely to agree with statements ‘rangeland weeds represent a problem to all ranchers’ and ‘biological agents released to control leafy spurge are safe for crops and native plants.’ Alternatively, ranchers with leafy spurge were more likely to strongly disagree with the statements ‘it seldom makes economic sense to control weeds on rangeland’ and ‘leafy spurge is virtually impossible to control with current control methods and techniques.’ Nearly all respondents strongly disagreed with the two statements ‘weed infestations have no effect on the market value of rangeland’ and ‘public land managers are doing a good job of controlling weeds on public land.’

Respondents were asked to indicate their perceptions of (1) effectiveness and (2) economics of four methods of controlling leafy spurge. The methods included (1) herbicides, (2) biological control - insects and pathogens, (3) grazing - sheep or goats, and (4) tillage. Regardless of whether the ranchers currently had leafy spurge, they indicated that tillage and/or reseeding (53 %) would most likely be ineffective at controlling leafy spurge (Table 9). Those ranchers who had leafy spurge were almost three times as likely to believe that grazing with sheep or goats would not be an effective control, 29 percent versus 11 percent, respectively. Alternatively, more than three-fourths of those ranchers with leafy spurge thought that spraying leafy spurge with a herbicide was economical. A comparison of responses by those producers who only had sheep versus those who only had cattle was not valid because only two respondents had only sheep.

Ranchers were asked whether they used several preventative measures to thwart the infestation or expansion of leafy spurge onto their property. More than 90 percent of ranchers routinely checked their range for invading plants (Appendix Table B5). While only 34 percent of ranchers believe that spraying leafy spurge with herbicides is very effective (61% believe it is partially effective), nearly 80 percent believe it is economical. About 97 percent of those ranchers

who currently have leafy spurge indicated that they use herbicides for control and 100 percent expect to use them in the future (Appendix Table B6). Slightly more than one-half of the ranchers indicated using biological control in the past and plan to use in the future, while only about 30 percent indicated using grazing of sheep and/or goats as a control method.

Ranchers were asked to indicate the reasons for not using these four main control methods. More than 50 percent of the respondents indicated that ‘environmental restrictions’ and ‘acreage of infestations were too large’ are the main reasons for not using herbicide treatments (Table 10). In addition, more than 50 percent of those ranchers with leafy spurge indicated that leafy spurge infestations were inaccessible to sprayers. The most common reason for not using biological agents was that they would take too long to work (48 %). Also, nearly one-third of those ranchers with leafy spurge did not believe that biological agents would work on their infestations. Not knowing where or how to use agents was only a concern to about 20 percent of those ranchers with leafy spurge. Nearly 75 percent of all respondents indicated that not having the right type of equipment was the most important reason for not using sheep and goats, although slightly more than 50 percent of those with leafy spurge indicated a lack of expertise with sheep or goats was also a reason. The most common reason for not using other methods of control (i.e., tillage, planting competing grasses, burning, mowing) was that land was not suitable for tillage (85 %).

In general, leafy spurge is a problem to control because of the land types the plant infests. Respondents with leafy spurge indicated controlling the weed could be economical with herbicides, but problems with using herbicides revolved around inaccessibility by sprayers and environmental regulations. Lack of leafy spurge control can lead to extensive infestations, and extensive infestations was a reason respondents mentioned for not using herbicide treatments. While it seems that data regarding the perceived economics of using herbicides is contradictory, it is more likely the manner in which the questions were asked. In one case (Table 9), the respondents were asked to indicate whether or not a particular practice ‘pays’. In another question (Table 10), the respondents were asked to check the statement, ‘herbicides are not economical’ if they felt that statement was a reason for not using herbicides. In both questions, the respondents were left to interpret the terms and situation of ‘it pays’ or ‘economical’ for themselves. Even if we could assume the same type, cost, and efficacy of a herbicide; some respondents may have access to a cost-sharing program within their area, others may have small patches which can be easily broadcast sprayed, or still others may have very large patches on which they simply spray the boundaries of the patch. The issue of economics is not entirely resolved within this survey because of the ambiguity of these questions.

Table 5. Weeds Posing Greatest Problems to Ranchers, 1998

Weed	Have leafy spurge:		Overall
	No	Yes	
	----- % indicated a <i>major</i> problem -----		
Leafy spurge *	29.9	63.3	48.6
Field bindweed	30.1	21.7	25.5
Thistles	28.2	22.6	25.2
Annual bromegrass	17.3	10.1	13.4
Sagebrush	11.8	5.3	8.2
Knapweeds ***	4.3	8.2	6.5
Prickly pear	8.7	2.4	5.3
Absinth wormwood	0.0	0.0	0.0
<u>Percentage indicated <i>most</i> important problem *</u>			
Leafy spurge	26.0	81.5	57.0
Thistles	22.0	3.3	11.5
Others <sup>1</sup>	16.4	3.3	9.1
Annual bromegrass	12.3	5.4	8.5
Sagebrush	15.1	1.1	7.3
Field bindweed	8.2	1.1	4.2
Knapweeds	0.0	3.3	1.8
Prickly pear	0.0	1.1	0.6
Absinth wormwood	0.0	0.0	0.0

<sup>1</sup> Other weeds listed included the following: hounds tongue, field pennycress, cheatgrass, burdock, Canada thistle, Sandburs/cockleburs, Tansy, Ragweed, fringed sage, and Locoweed.

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't for each type of weed considered a *major* problem (Chi-square test statistic). Statistical test for the weed considered to be the *most* important problem were tested simultaneously (Chi-square test statistic).

\*\*\* Statistically different at  $P \leq 0.10$  between those who have leafy spurge and those who don't for each type of weed considered a *major* problem (Chi-square test statistic).

Table 6. Percentage of Ranchers Indicating the Manner in Which Leafy Spurge Infestations Expanded, 1998

Methods of Spreading	Have leafy spurge:		Overall
	No	Yes	
	-- % indicated two most important reasons --		
Spread from adjoining land *	53.3	71.7	63.6
Not recognized as threat until too late	42.9	42.4	42.6
Lack of cost effective controls	31.2	26.5	28.6
Spread by man's actions *	40.3	19.2	28.4
Other reasons * <sup>1</sup>	3.9	16.3	10.9
Overgrazing of rangeland	7.8	8.2	8.0
Lack of competition from native plants	5.2	3.1	4.0

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't for each method of spreading (Chi-square test statistic).

<sup>1</sup> Sixty percent indicated other reasons as spread by deer and birds, followed by 10 percent indicating lack of something to kill the invasive weed.

Table 7. Ranchers' Perceptions of the Seriousness of the Weed Problem on Their Ranch, 1998

Perception of Weed Problem *	Have leafy spurge:		Overall
	No	Yes	
	----- % -----		
Not a problem	27.1	9.8	17.3
Minor problem	67.1	64.1	65.4
Major problem	5.7	26.1	17.3

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't across all categories of problems (Chi-square test statistic).

Table 8. Ranchers' Opinions and Perceptions about Weed Management in General, Leafy Spurge Infestations, and Methods of Leafy Spurge Control, 1998

Statement	Have leafy spurge:		Overall
	No	Yes	
	----- average score <sup>1</sup> -----		
I am concerned about controlling weeds in rangeland **	4.6	4.9	4.8
Leafy spurge is a long-term management problem	4.6	4.6	4.6
State and Federal government agencies are not doing enough to control problem weeds on public grazing land	4.6	4.5	4.5
Rangeland weeds represent a problem to all ranchers **	4.1	4.5	4.4
Biological agents released to control leafy spurge are safe for crops and native plants **	3.9	4.4	4.2
The expected payoff from biological control of leafy spurge justifies investment of public funds to develop the process	4.1	4.3	4.2
Herbicides, if used properly, are not harmful to the environment	4.0	4.0	4.0
There needs to be more research on controlling weeds in rangeland	4.0	4.1	4.0
State and Federal government agencies are not doing enough to help control problem weeds on private grazing land **	3.9	3.5	3.7

- continued -

Table 8. Continued

Statement	Have leafy spurge:		Overall
	No	Yes	
	----- average score <sup>1</sup> -----		
Restrictions affecting the use of herbicides on rangeland are too strict	3.8	3.5	3.6
Governments should help pay part of the cost to control leafy spurge, even if it means an increase in taxes	3.6	3.5	3.5
Local governments are not effective in controlling problem weeds	3.5	3.4	3.4
Weed problems in rangeland are generally the result of poor range management	3.3	3.1	3.2
Leafy spurge can be controlled but it is just too costly	3.3	3.1	3.2
Biological control will eventually eliminate the leafy spurge problem	2.9	2.6	2.8
It doesn't pay to control weeds on my land when my neighbor doesn't control his weeds	2.8	2.6	2.7
Leafy spurge is virtually impossible to control with current control methods and techniques **	3.0	2.5	2.7
It seldom makes economic sense to control weeds on rangeland **	2.2	1.6	1.9
Weeds infestations have no effect on the market (sale) value of rangeland	1.6	1.7	1.7
Public land managers are doing a good job of controlling weeds on public land	1.6	1.8	1.7

<sup>1</sup> Based on a score of 1 to 5, where 1 is strongly disagree and 5 is strongly agree.

\*\* Statistically different at  $P \leq 0.05$  between those who have leafy spurge and those who don't for each type statement (T-test).

Table 9. Ranchers' Belief in Most Effective and Economical Methods to Control Leafy Spurge, 1998

Control Methods	Have leafy spurge:		Overall
	No	Yes	
<u>Effectiveness of these practices in controlling leafy spurge</u>	--- % indicated not effective ---		
Tillage &/or reseeding	50.0	56.1	53.3
Grazing with sheep or goats **	11.3	28.6	20.9
Biological control with insects or pathogens	7.7	12.2	10.3
Spraying with herbicide ***	9.0	5.3	6.8
<u>Economical to use these practices in controlling leafy spurge</u>	--- % indicating it pays ---		
Spraying with herbicide ***	60.0	77.1	70.2
Biological control with insects or pathogens	69.2	64.4	66.4
Grazing with sheep or goats	59.4	52.9	56.0
Tillage &/or reseeding	27.5	13.5	20.4

\*\* Statistically different at  $P \leq 0.05$  between those who have leafy spurge and those who don't for each control method (Chi-square test statistic).

\*\*\* Statistically different at  $P \leq 0.10$  between those who have leafy spurge and those who don't for each control method (Chi-square test statistic).

Table 10. Based Upon What Ranchers Experienced, Believed, or Had Been Told, Their Indication of Why the Following Controls Are Not Used on Leafy Spurge, 1998

Reasons for not using controls	Have leafy spurge:		Overall
	No	Yes	
<b>Reasons for not using herbicide treatments</b>	-- % indicated reason for not using --		
Environmental restrictions/concerns prevent me from applying herbicides (such as spraying near water, trees, sensitive crops, etc.)	57.6	66.7	62.2
Acreage of infestations are so large that the cost of using herbicides would be prohibitively expensive	51.5	52.2	51.8
Herbicides are not economical	50.0	42.0	45.9
Leafy spurge infestations are inaccessible to sprayers **	31.8	52.2	42.2
Do not have the time to treat the leafy spurge infestations *	19.7	40.6	30.4
Herbicides are ineffective in controlling leafy spurge	30.3	20.3	25.2
Cost-share programs for herbicides are no longer available or have been reduced	37.9	27.5	32.6
Lack the equipment or expertise to apply herbicides **	25.8	11.6	18.5
Others reasons *** 1	0.0	4.4	2.2
<b>Reasons for not using biological controls</b>			
Biological agents take too long to work **	36.7	57.4	48.2
Limited access to biological agents (cannot collect sufficient numbers of the agents)	49.0	41.0	44.6
Do not know how to obtain or where to obtain the insects *	55.1	19.7	35.5
Do not know how to properly use the agents **	40.8	21.3	30.0
Do not have the time to work with biological agents	16.3	29.5	23.6
Biological agents will not likely work on my leafy spurge infestations *	4.1	31.2	19.1

- continued -

Table 10. continued

Reasons for not using controls	Have leafy spurge:		Overall
	No	Yes	
Afraid the agents will spread or attack other plants	18.4	14.8	16.4
Biological agents are not economical	18.4	4.9	10.9
Biological agents will eventually spread to my leafy spurge without my help	10.2	4.9	7.3
Other reasons <sup>2</sup>	0.0	3.3	1.8
<b>Reasons for not using sheep &amp;/or goats</b>			
Do not have the right equipment (fences, water, shelter) for sheep and goats	73.8	71.4	72.3
Sheep and goats will compete with cattle for the same forage	38.1	46.8	43.7
Do not have the expertise/knowledge to work with sheep and goats *	23.8	50.7	41.2
Sheep and goats are too time consuming to use **	26.2	48.1	40.3
I do not like sheep or goats ***	23.8	41.6	35.3
Sheep and goats are too costly to manage/not economical to use **	11.9	29.9	23.5
Sheep and goats are ineffective in controlling leafy spurge	16.7	28.6	24.4
Other reasons <sup>3</sup>	11.9	14.3	13.5
<b>Reasons for not using other control methods</b>			
Land is not suitable for tillage (inaccessible, incompatible terrain, light soil, too rocky, etc)	86.4	83.9	84.9
These methods are ineffective	30.5	39.1	35.6
Do not have enough time to work with those methods	22.0	31.0	27.4
Lack the proper equipment ***	30.5	18.4	23.3
Do not know how to use these methods	17.0	25.3	21.9
Other reasons <sup>4</sup>	1.7	5.8	4.1

<sup>1</sup> Other reasons listed include: federal land not funded for spraying, never enough time, and perimeter control must dominate to have success.

<sup>2</sup> Other reasons listed include: area too small to sustain a population and have trouble establishing.

<sup>3</sup> Other reasons listed include: not enough leafy spurge, will not eradicate - but will control, and didn't work

<sup>4</sup> Other reasons listed include: tilling stirs seeds and enhances spreading, location, burning sets grass back too far, and too much brush and timber.

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't for each reason (Chi-square test statistic).

\*\* Statistically different at  $P \leq 0.05$  between those who have leafy spurge and those who don't for each reason (Chi-square test statistic).

\*\*\* Statistically different at  $P \leq 0.10$  between those who have leafy spurge and those who don't for each reason (Chi-square test statistic).

### Weed Management Information: Sources and Types

The Extension Service is the major source of farming/ranching information to ranchers in the survey area. More than 48 percent of all respondents indicated that they frequently use the Extension Service to obtain information about weed management on grazing or hay land (38 % indicated the Extension Service was the most important source) (Table 11). However, the most

frequently used source of information on weed management for those who have leafy spurge was the county weed board (52 %). The county weed board was also the most important source of information to those with leafy spurge (37 %).

Types of information wanted most by respondents who have leafy spurge were effectiveness of various herbicide treatment programs (57 %), economics of herbicide treatments (52 %), how to get started with biological control (51 %), and economics of biological control (48 %) (Table 12). The form in which most respondents wanted information was as a pamphlet or bulletin through the local Extension office (49 %). Area demonstration plots were also mentioned as a form of choice by almost 40 percent of all respondents.

Nearly one-half of the respondents (46 %) use a computer on their ranch (Table 13). Comparing those ranchers who use a computer to those who would like access to computer decision aids software revealed that 57 percent of computer users were interested in decision aid software.

Table 11. Sources of Weed Management Information Most Often Used By Ranchers, 1998

Source of Weed Management Information	Have leafy spurge:		Overall
	No	Yes	
	-- % indicated used frequently --		
Extension Service/county agent/universities	47.3	49.0	48.2
County weed board/officers *	38.4	52.1	46.1
Other ranchers/neighbors	41.7	43.8	42.9
Farm/ranch/trade magazines	20.0	30.7	26.0
Other <sup>1</sup>	25.0	20.0	23.1
Private companies/consultants	11.8	14.1	13.1
Grazing associations	6.2	18.3	12.9
Government agencies	9.0	14.5	12.0
Internet/On-line computer services/DTN ***	3.0	5.2	4.2
Public land managers (BLM, Forest Service) **	1.5	6.1	4.1
	-- % indicated <i>most</i> important source --		
Extension Service/county agent/universities	41.1	35.9	38.2
County weed board/officers	21.9	37.0	30.3
Other ranchers/neighbors	13.7	9.8	11.5
Private companies/consultants	11.0	2.2	6.1
Farm/ranch/trade magazines	4.1	6.5	5.5
Grazing associations	2.7	4.4	3.6
Government agencies	4.1	1.1	2.4
Other <sup>1</sup>	1.4	2.2	1.8
Public land managers (BLM, Forest Service)	0.0	1.1	0.6

<sup>1</sup> Other sources indicated were: common sense, weed control seminars, and herbicide dealers.

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't for each information source (Chi-square test statistic).

\*\* Statistically different at  $P \leq 0.05$  between those who have leafy spurge and those who don't for each information source (Chi-square test statistic).

\*\*\* Statistically different at  $P \leq 0.10$  between those who have leafy spurge and those who don't for each information source (Chi-square test statistic).

Table 12. Types of Weed Management Information Most Wanted By Ranchers, 1998

Type of Information	Have leafy spurge:		Overall
	No	Yes	
-- % indicated very interested --			
Effectiveness of various herbicide treatment programs *	33.3	56.5	46.3
Economics of herbicide treatments ***	33.3	51.7	43.6
Economics of biological control **	28.8	48.2	39.6
How to get started with biological control *	22.1	50.6	37.9
Economics of using sheep and goats	22.9	22.0	22.4
Techniques and effectiveness of control with sheep and goats	17.9	22.9	20.7
Others <sup>1</sup>	0.0	33.3	15.4
Techniques and effectiveness of cultivation and reseeded	15.2	13.3	14.1
Economics of cultivation and reseeded	15.2	12.1	13.4
<u>Form of Information</u>			
Pamphlet or bulletin available through Extension office or county agent	44.0	52.1	48.5
Testimonials from fellow ranchers and other land managers	37.0	43.8	40.7
Area demonstration plots showing the effectiveness of various control methods	30.0	44.8	38.2
Video cassettes demonstrating the various control methods	34.3	36.8	35.7
Others *** <sup>2</sup>	0.0	50.0	33.3
Personal visits and on-site help by range management specialists **	20.3	39.3	31.0
Computer decision aids (programs) that can be used by ranchers to evaluate the feasibility or economics of various controls	10.1	13.3	11.8

<sup>1</sup> Other types of information indicated was desire to know the long term effect.

<sup>2</sup> Other forms of information specified included: at my request, and license renewal seminars, and books.

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't for each type of information (Chi-square test statistic).

\*\* Statistically different at  $P \leq 0.05$  between those who have leafy spurge and those who don't for each type of or form of information (Chi-square test statistic).

\*\*\* Statistically different at  $P \leq 0.10$  between those who have leafy spurge and those who don't for each type of or form of information (Chi-square test statistic).

Table 13. Respondents Who Use a Computer on Ranch and Desire for Decision Software, 1998

Type of Information	No	Yes	Overall
Use computer on ranch:	53.8%	46.2%	100.0%
n	92	79	171
	-- indicated somewhat/very interested --		
Computer on ranch and number interested in computer decision aids to help evaluate feasibility or economics of various controls *	43.0%	57.0%	100.0%
n	34	45	79

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who don't (Chi-square test statistic).

## CONCLUSIONS AND IMPLICATIONS

Leafy spurge is a problem for ranchers in the five county study area as evidenced by the nearly 60 percent who said they currently have leafy spurge on their ranch. Acreage of leafy spurge relative to acreage operated was relatively small; acreage of leafy spurge averaged less than 3 percent of acreage operated. North Dakota had the greatest percentage of respondents with leafy spurge; however, Wyoming had the highest rate of leafy spurge infestation. Invasive weeds and regulations affecting use of public lands were more of a problem to those producers who had leafy spurge than those who did not. However, probably most revealing was that only 10 percent of those producers who currently have leafy spurge thought it was their most important problem (they thought livestock prices, adverse weather conditions, and availability of grazing land were more important problems than leafy spurge).

Two factors pose a concern about the spread of leafy spurge: (1) most respondents indicated that they believe it is spread from adjoining land and (2) it is not recognized as a problem until too late. These factors could pose a concern, combined with the fact that only about one-quarter of those respondents who do not currently have leafy spurge believe that leafy spurge is their most important invasive weed. Furthermore, while more than 75 percent of ranchers with leafy spurge felt that control with herbicides was economical, more than 50 percent also indicated that infestations were typically in areas which were inaccessible to sprayers. More than 50 percent of all respondents felt that environmental restrictions and too large infestations were the main reasons for not using herbicide treatments.

Nearly 50 percent of respondents thought that biological agents would 'take too long' to work to warrant trying to use them. Of those with leafy spurge, about one-third did not think the agents would work on their particular infestations. Twenty-nine percent of ranchers with leafy spurge did not think grazing with sheep or goats would provide effective control, and almost 75 percent of all respondents indicated not having the right type of equipment was the main barrier to using sheep and goats for control. The main reason (85 %) listed for not using other methods for controlling leafy spurge was that the land was not suitable for tillage. More than 50 percent of all respondents indicated that tillage and/or reseeding would not be an effective means of controlling leafy spurge.

The most frequently used and most important source of information on weed management was the Extension Service. Those respondents who currently had leafy spurge on their ranch thought the most important source of weed management information was their county weed board/officers, followed closely by the Extension Service. The most important type of information wanted by respondents was the effectiveness of various herbicide treatment programs and they wanted this information in pamphlet or bulletin. Those producers who currently have leafy spurge also indicated that area demonstration plots showing the effectiveness of various controls would be valuable. Also, nearly 50 percent of the ranchers indicated using a computer on their ranch and of these, and about 60 percent of these would be very interested in computer decision aids.

Overall, this survey has revealed that nearly all ranchers were concerned about controlling weeds on rangeland, that they believe rangeland weeds represent a problem to all ranchers, and that leafy spurge is viewed as a long-term management problem. Those ranchers, who currently have leafy spurge on their ranch, more strongly agree that they are concerned about controlling weeds on rangeland, that rangeland weeds represent a problem to all ranchers, and that biological agents released to control leafy spurge are safe for crops and native plants. Further, the respondents indicated that they would like to see state and federal government agencies do more to control problem weeds on public grazing land. Most respondents were in disagreement with the statements that weed infestations had no effect on the market value of rangeland or that public land managers are doing a good job controlling weeds, regardless of whether or not the respondents currently have a leafy spurge infestation.

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# Appendix A

Weed Management Survey Administered to Ranchers, 1998

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## WEED MANAGEMENT SURVEY

### Ranch Operators

The following questions pertain to grazing and weed management issues in **your area or region**.

1. Please rate each of the following problems/issues that may affect livestock grazing operations in your area: (circle the appropriate number)

	Not a Problem	Minor Problem	Major Problem	Don't Know
a. adverse weather conditions	1	2	3	4
b. availability of grazing land	1	2	3	4
c. cost of feed and supplies	1	2	3	4
d. livestock prices	1	2	3	4
e. noxious or invasive weeds	1	2	3	4
f. predators	1	2	3	4
g. regulations affecting use of public lands	1	2	3	4
h. use of CRP for haying and grazing	1	2	3	4
i. others (please specify _____)	1	2	3	4

2. Which problem/issue listed in Question 1 do you feel is the **most serious** problem affecting grazing operations in your area? (**Circle** the appropriate letter)

3. Have these problems/issues in your area improved, remained the same, or become worse over the past five years?

	Improved	Remained the Same	Become Worse	Don't Know
a. adverse weather conditions	1	2	3	4
b. availability of grazing land	1	2	3	4
c. cost of feed and supplies	1	2	3	4
d. livestock prices	1	2	3	4
e. noxious or invasive weeds	1	2	3	4
f. predators	1	2	3	4
g. regulations affecting use of public lands	1	2	3	4
h. use of CRP for haying and grazing	1	2	3	4
i. others (please specify _____)	1	2	3	4

4. Which weeds pose problems for livestock grazing operations in your area? (please rate each of following weeds)

	Not a Problem	Minor Problem	Major Problem	Don't Know
a. annual brome-grasses	1	2	3	4
b. knapweeds	1	2	3	4
c. leafy spurge	1	2	3	4
d. prickly pear	1	2	3	4
e. sagebrush	1	2	3	4
f. thistles	1	2	3	4
g. wormwood (absinth)	1	2	3	4
h. field bindweed	1	2	3	4
i. others (please specify _____)	1	2	3	4

5. Which weed listed above currently poses the **most serious** problem for grazing operations in your area? (**Circle** the appropriate letter)

6. What do you think are the two most important primary causes of invasive weed (e.g. leafy spurge, knapweed) infestations in your area? (circle the two most important)

- a. infestation spread from adjoining land
- b. not recognized as a problem/threat until its too late
- c. spread by man's actions (e.g., vehicles, contaminated hay)
- d. overgrazing of rangeland
- e. lack of competition from native plants/grasses
- f. lack of cost effective controls
- g. other (\_\_\_\_\_ please specify)

The following questions pertain only to **your farm or ranch operation**.

7. How serious is the weed problem on your farm or ranch? (please circle)

not a problem                      minor problem                      major problem

Please estimate how many **acres** of the following weeds are on your farm/ranch?

	Grazing Land	Hay Land
a. annual brome-grasses	_____	_____
b. knapweeds	_____	_____
c. leafy spurge	_____	_____
d. prickly pear	_____	_____
e. sagebrush	_____	_____
f. thistles	_____	_____
g. wormwood	_____	_____
h. field bindweed	_____	_____
i. others (specify _____)	_____	_____

8. What measures have you taken to prevent leafy spurge from establishing itself on your farm/ranch?

- |                                                                                |     |    |
|--------------------------------------------------------------------------------|-----|----|
| a. purchase only weed-free hay                                                 | Yes | No |
| b. keep machinery/trucks clean                                                 | Yes | No |
| c. aggressively destroy weeds when found                                       | Yes | No |
| d. spot spraying near fringe or boundary areas                                 | Yes | No |
| e. routinely check range for invading plants                                   | Yes | No |
| f. insist that local governments control leafy spurge in road ways and ditches | Yes | No |
| g. other measures (please specify _____)                                       | Yes | No |

9. Do you currently have any leafy spurge on your farm or ranch?

\_\_\_ No (if **No**, go to Question 10)

\_\_\_ If **Yes**, please indicate if you have used or plan to use any of the following general control practices to control leafy spurge: (check all that apply)

- |                                                       | Have Used<br>in the Past | Plan to<br>Use |
|-------------------------------------------------------|--------------------------|----------------|
| a. herbicides                                         | Y / N (# of years _____) | Y / N          |
| b. biological control                                 | Y / N (# of years _____) | Y / N          |
| c. sheep or goats                                     | Y / N (# of years _____) | Y / N          |
| d. tillage and/or reseeding<br>with competing grasses | Y / N (# of years _____) | Y / N          |
| e. other controls (please specify<br>_____)           | Y / N (# of years _____) | Y / N          |

10. Even if you currently have no leafy spurge, how would you rate the **effectiveness** of the following practices in controlling leafy spurge?

- |                                                           | Not<br>Effective | Partially<br>Effective | Very<br>Effective | Don't<br>Know |
|-----------------------------------------------------------|------------------|------------------------|-------------------|---------------|
| a. spraying with herbicides                               | 1                | 2                      | 3                 | 4             |
| b. biological control with<br>insects or pathogens        | 1                | 2                      | 3                 | 4             |
| c. control with grazing animals<br>such as sheep or goats | 1                | 2                      | 3                 | 4             |
| d. tillage and/or reseeding<br>with competing grasses     | 1                | 2                      | 3                 | 4             |
| e. other controls (please specify<br>_____)               | 1                | 2                      | 3                 | 4             |

11. Even if you currently have no leafy spurge, do you think it pays to use the following leafy spurge control practices?

	Yes, It Pays	Marginal	Does Not Pay	Don't Know
a. spraying with herbicides	1	2	3	4
b. biological control with insects or pathogens	1	2	3	4
c. control with grazing animals such as sheep or goats	1	2	3	4
d. tillage and/or reseeding with competing grasses	1	2	3	4
e. other controls (please specify _____)	1	2	3	4

12. Based on what you have experienced, believe, or have been told, please indicate the reasons for **not** using the following control methods on leafy spurge.

Reasons for **not** using **herbicide treatments**: (check all that apply)

- Leafy spurge infestations are inaccessible to sprayers
- Herbicides are not economical
- Herbicides are ineffective in controlling leafy spurge
- Environmental restrictions/concerns prevent me from applying herbicides (such as, spraying near water, trees, sensitive crops, etc.)
- Do not have the time to treat the leafy spurge infestations
- Acreage of infestations are so large that the cost of using herbicides would be prohibitively expensive
- Lack the equipment or expertise to apply herbicides (such as restricted use permits)
- Cost-share programs for herbicides are no longer available or have been reduced
- Others reasons (please list \_\_\_\_\_)

Reasons for **not** using **biological controls**: (check all that apply)

- Biological agents take too long to work
- Do not know how to properly use the agents
- Biological agents are not economical
- Do not know how to obtain or where to obtain the insects
- Limited access to biological agents (cannot collect sufficient numbers of the agents)
- Do not have the time to work with biological agents
- Biological agents will not likely work on my leafy spurge infestations
- Afraid the agents will spread or attack other plants
- Biological agents will eventually spread to my leafy spurge without my help
- Other reasons (please list \_\_\_\_\_)

Reasons for **not** using **sheep and/or goats**: (check all that apply)

- Do not have the expertise/knowledge to work with sheep and goats
- Do not have the right equipment (fences, water, shelter) for sheep and goats
- Sheep and goats are too time consuming to use
- Sheep and goats will compete with cattle for the same forage
- Sheep and goats are too costly to manage/not economical to use
- Sheep and goats are ineffective in controlling leafy spurge
- I do not like sheep or goats
- Other reasons (please list \_\_\_\_\_)

Reasons for **not** using **other methods**, such as tillage, planting competing grasses, burning, mowing: (check all that apply)

- Do not know how to use these methods
- These methods are ineffective
- Lack the proper equipment
- Do not have enough time to work with those methods
- Land is not suitable for tillage (inaccessible, incompatible terrain, light soil, too rocky, etc.)
- Other reasons (please list \_\_\_\_\_)

13. When you need information about **weed management on grazing land**, which of the following sources do you use?

	Seldom	Sometimes	Frequently	Never
a. Extension Service/county agent/universities	1	2	3	4
b. private companies/consultants	1	2	3	4
c. farm/ranch/trade magazines	1	2	3	4
d. grazing associations	1	2	3	4
e. public land managers (BLM, Forest Service)	1	2	3	4
f. Internet/On-line computer services/DTN	1	2	3	4
g. other ranchers/neighbors	1	2	3	4
h. county weed board/officers	1	2	3	4
i. government agencies	1	2	3	4
j. other (specify _____)	1	2		34

14. Which one has been the **most valuable** source of information for weed management on grazing land? (**Circle** the appropriate letter above)

15. What type of information would you like to obtain concerning weed management on grazing and hay land?

	Not Interested	Somewhat Interested	Very Interested
a. effectiveness of various herbicide treatment programs	1	2	3
b. economics of herbicide treatments	1	2	3
c. how to get started with biological control	1	2	3
d. economics of biological control	1	2	3
e. techniques and effectiveness of control with sheep and goats	1	2	3
f. economics of using sheep and goats	1	2	3
g. techniques and effectiveness of cultivation and reseeding	1	2	3
h. economics of cultivation and reseeding	1	2	3
i. others (please specify _____)	1	2	3

16. In what form would you like to receive the information?

	Not Interested	Somewhat Interested	Very Interested
a. pamphlet or bulletin available through Extension office or county agent	1	2	3
b. video cassettes demonstrating the various control methods	1	2	3
c. area demonstration plots showing the effectiveness of various control methods	1	2	3
d. testimonials from fellow ranchers and other land managers	1	2	3
e. computer decision aids (programs) that can be used by ranchers/farmers to evaluate the feasibility or economics of various controls	1	2	3
f. personal visits and on-site help by range management specialists	1	2	3
g. others (please specify _____)	1	2	3

The next set of questions asks what you think about general weed management issues and concerns dealing with leafy spurge.

17. Please indicate whether you agree or disagree with the following statements:

	Strongly Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Strongly Agree	Don't Know
<u>Weed Management</u>						
Weed problems in rangeland are generally the result of poor range management	1	2	3	4	5	0
I am concerned about controlling weeds in rangeland	1	2	3	4	5	0
State and Federal government agencies are not doing enough to control problem weeds on <u>public</u> grazing land	1	2	3	4	5	0
State and Federal government agencies are not doing enough to help control problem weeds on <u>private</u> grazing land	1	2	3	4	5	0
Local governments are not effective in controlling problem weeds	1	2	3	4	5	0
It seldom makes economic sense to control weeds on rangeland	1	2	3	4	5	0
Rangeland weeds represent a problem to all ranchers	1	2	3	4	5	0
It doesn't pay to control weeds on my land when my neighbor doesn't control his weeds	1	2	3	4	5	0
There needs to be more research on controlling weeds in rangeland	1	2	3	4	5	0
Restrictions affecting the use of herbicides on rangeland are too strict	1	2	3	4	5	0

	Strongly Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Strongly Agree	Don't Know
Herbicides, if used properly, are not harmful to the environment	1	2	3	4	5	0
Weeds infestations have no effect on the market (sale) value of rangeland	1	2	3	4	5	0
Public land managers are doing a good job of controlling weeds on public land	1	2	3	4	5	0
<u>Leafy Spurge</u>						
Leafy spurge is virtually impossible to control with current control methods and techniques	1	2	3	4	5	0
Leafy spurge can be controlled but it is just too costly	1	2	3	4	5	0
Leafy spurge is a long-term management problem	1	2	3	4	5	0
Biological agents released to control leafy spurge are safe for crops and native plants	1	2	3	4	5	0
The expected payoff from biological control of leafy spurge justifies investment of public funds to develop the process	1	2	3	4	5	0
Biological control will eventually eliminate the leafy spurge problem	1	2	3	4	5	0
Governments should help pay part of the cost to control leafy spurge, even if it means an increase in taxes	1	2	3	4	5	0

We would now like to ask a few general questions about the characteristics of your farm/ranch. These responses will help us to compare differences and similarities of the survey respondents based on ranch characteristics.

18. In 1996, how many acres did you:

	Hay Land/ Cropland	Grazing Land	Total
a. Own	_____	_____	_____
b. Rent or lease from others	_____	_____	_____
c. Rent or lease to others		_____	_____

19. How many head of livestock did you graze in 1996?

	Estimated Number of Head
Cattle and calves	_____
Sheep and lambs	_____
Horses	_____
Others (specify _____)	_____

20. Did you use any public (federal and/or state) land for grazing in 1996? Yes / No

If **Yes**, how many acres \_\_\_\_\_ or number of permitted AUMs \_\_\_\_\_ ?

21. What best describes your farm organization? (please circle)

- a. single proprietor
- b. partnership
- c. family corporation
- d. other (please clarify \_\_\_\_\_)

22. Do you use a computer to assist you in the operation of your farm or ranch? Yes / No

If **yes**, do you have access to the Internet? Yes / No

The following questions ask for financial information pertaining to your farming/ranching activities in 1996. If you are in a partnership or corporation, please answer for the entity and **not** just for your share. PLEASE BE ASSURED THAT RESPONSES WILL BE AVERAGED OVER SEVERAL COUNTIES **AND YOUR INDIVIDUAL RESPONSES WILL BE KEPT STRICTLY CONFIDENTIAL**. These responses help compare attitudes and perceptions based on financial characteristics of survey respondents.

23. Which of the following categories best describes your **gross farm income** (exclude hunting and oil/gas lease income) in 1996?

- |                           |                           |
|---------------------------|---------------------------|
| a. \$50,000 or less       | e. \$200,001 to \$250,000 |
| b. \$50,001 to \$100,000  | f. \$250,001 to \$300,000 |
| c. \$100,001 to \$150,000 | g. \$300,001 to \$350,000 |
| d. \$150,001 to \$200,000 | h. Over \$350,000         |

24. Which of the following categories best describes your **net farm income** (gross cash farm income less gross cash farm expenses) in 1996?

- |                         |                         |
|-------------------------|-------------------------|
| a. negative             | e. \$20,001 to \$30,000 |
| b. \$0 to \$5,000       | f. \$30,001 to \$40,000 |
| c. \$5,001 to \$10,000  | g. \$40,001 to \$50,000 |
| d. \$10,001 to \$20,000 | h. Over \$50,000        |

25. Approximately what percentage of your gross farm income in 1996 came from grazing livestock?

\_\_\_\_\_ percent

26. About what percentage of your total family income (includes net farm income, off-farm earnings, oil or gas lease income, income from investments, etc.) in 1996 came from farming/ranching?

\_\_\_\_\_ percent

We would now like to ask a few questions about you for statistical purposes. This information will not be disclosed on an individual basis.

27. In what county and state do you live? \_\_\_\_\_ County \_\_\_\_\_ State

28. How long have you lived in this county? \_\_\_\_\_ Years

29. What is your age? \_\_\_\_\_ Years

30. Which of the following categories best describes the highest level of education you have completed?

- a. Did not complete high school
- b. High school graduate
- c. Vocational/Technical or 2-year college degree
- d. Bachelor's Degree (4-year college program)
- e. Graduate School (Masters and/or Doctorate Degree)

31. How many years have you been farming/ranching? \_\_\_\_\_

32. In 1996, did you work at an off-farm job?

\_\_\_\_\_ No

\_\_\_\_\_ Yes, about how many days did you work at least 4 hours per day off your farm/ranch? \_\_\_\_\_ days

**Thank you** for completing this questionnaire. Your cooperation is sincerely appreciated. If you would like a report summarizing the findings of this study, please provide your name and mailing address or send a separate postcard with your request:

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# Appendix B

Comparison of Survey Responses By State of Residence

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Appendix Table B1. Comparison of Characteristics of Ranch Operators by State, 1998

	North Dakota	Montana	South Dakota	Wyoming
Sample size	132	70	133	124
Completed surveys	53	34	46	54
Response rate	40.2 %	48.6 %	34.6 %	43.5 %
Total Acreage Operated: (mean)	3,459 <sup>a</sup>	7,463	7,637	9,609
Livestock grazed: <sup>1</sup>				
Cow/calf (mean)	255 <sup>a</sup>	470	495	558
Sheep (mean)	509	829	1,539	1,210
Horses (mean)	6	6	8	10
Ranches Grazing Public Land (%) <sup>*</sup>	55.6	96.6	70.5	76.1
Currently Have Leafy Spurge on Place: (%) <sup>*</sup>	72.0	44.1	34.9	64.0
Percentage Income From Grazing (mean)	64.4 <sup>a</sup>	83.8	89.4	84.8
Distribution:				
50 % or less	40.0	17.7	9.3	10.0
51 to 75 %	16.0	11.8	7.0	16.0
76 to 90 %	16.0	23.5	25.6	14.0
More than 90 %	28.0	47.1	58.1	60.0

<sup>a</sup> North Dakota significantly different from other states ( $P \leq 0.05$ ) (Duncan-Tukey).

<sup>1</sup> Mean represents those who reported having these livestock.

<sup>\*</sup> Statistically different at  $P \leq 0.01$  between states (Chi-square test statistic).

Appendix Table B2. Problems Faced by Ranchers and Changes in Problems in Past Five Years By State, 1998

	North Dakota	Montana	South Dakota	Wyoming
	----- % indicated a <i>major</i> problem -----			
Livestock prices	83.3	76.5	81.4	73.5
Adverse weather conditions *	41.7	88.2	79.1	51.0
Cost of feed and supplies	54.2	56.3	48.8	50.0
Predators *	15.2	66.7	30.2	39.6
Regulations affecting use of public lands **	51.1	42.4	12.8	31.9
Noxious or invasive weeds *	42.0	30.3	2.3	40.4
Availability of grazing land	39.6	12.1	22.5	22.9
Use of CRP for haying and grazing ***	19.6	10.7	12.5	7.7
	----- % indicated <i>most</i> important problem -----			
Livestock prices	31.8	15.6	37.5	38.8
Adverse weather conditions	20.5	37.5	32.5	16.3
Cost of feed and supplies	6.8	15.6	10.0	8.2
Predators	0.0	6.3	5.0	8.2
Regulations affecting use of public lands	15.9	6.3	0.0	10.2
Noxious or invasive weeds	9.1	9.4	0.0	10.2
Availability of grazing land	9.1	6.3	7.5	8.2
Use of CRP for haying and grazing	2.3	0.0	2.5	0
	% indicated problem became worse in past five years			
Livestock prices	75.0	51.5	65.1	71.4
Adverse weather conditions **	22.9	20.6	46.5	14.3
Cost of feed and supplies	58.3	57.6	67.4	73.5
Predators *	15.6	81.8	46.5	54.2
Regulations affecting use of public lands	59.5	54.6	38.9	61.4
Noxious or invasive weeds *	43.8	52.9	16.7	54.2
Availability of grazing land **	32.6	24.2	21.4	60.4
Use of CRP for haying and grazing	13.0	4.2	10.5	7.1

\* Statistically different at  $P \leq 0.01$  between states (Chi-square test statistic).

\*\* Statistically different at  $P \leq 0.05$  between states (Chi-square test statistic).

\*\*\* Statistically different at  $P \leq 0.10$  between states (Chi-square test statistic).

Appendix Table B3. Percentage of Ranchers Indicating Specific Weeds Posing Greatest Problem By State, 1998

	North Dakota	Montana	South Dakota	Wyoming
	----- % indicated a <i>major</i> problem -----			
Leafy spurge *	57.1	59.4	18.6	59.2
Field bindweed	19.2	33.3	28.2	25.5
Thistles **	21.3	22.6	11.9	42.9
Annual brome-grasses **	9.3	20.0	26.2	2.1
Sagebrush	10.6	12.9	7.0	4.3
Knapweeds **	0.0	10.0	0.0	15.2
Prickly pea **	2.6	7.1	13.2	0.0
Wormwood (absinth)	0.0	0.0	0.0	0.0
	---- % indicated <i>most</i> important problem * ----			
Leafy spurge	71.7	66.7	25.6	62.5
Thistles	10.9	3.3	12.8	16.7
Annual brome-grasses	0.0	10.0	23.1	4.2
Sagebrush	4.4	10.0	12.8	4.2
Field bindweed	6.5	0.0	5.1	2.1
knapweeds	0.0	0.0	5.1	2.1
Prickly pear	0.0	0.0	2.6	0.0
Wormwood (absinth)	0.0	0.0	0.0	0.0

\* Statistically different at  $P \leq 0.01$  between states (Chi-square test statistic).

\*\* Statistically different at  $P \leq 0.05$  between states (Chi-square test statistic).

Appendix Table B4. Ranchers' Perception of the Weed Problem on Their Ranch By State, 1998

Perception of Weed Problem	North Dakota	Montana	South Dakota	Wyoming	Overall
	----- % -----				
--					
Not a problem	23.9	13.3	20.5	10.2	17.1
Minor problem	54.4	73.4	71.8	65.3	65.2
Major problem	21.7	13.3	7.7	24.5	17.7
Total	100.0	100.0	100.0	100.0	100.0

Appendix Table B5. Ranchers Use of Practices to Prevent Leafy Spurge Infestations and Perception of the Effectiveness and Economics of Control Practices, By State, 1998

Control Method or Practice	North Dakota		Montana		South Dakota		Wyoming		Total		Overall
	no	yes	no	yes	no	yes	no	yes	no	yes	
	----- % indicating they use method/practice -----										
Purchase only weed-free hay	88.9	65.6	66.7	50.0	84.0	81.8	69.2	70.4	77.4	67.1	71.5
Keep machinery/trucks clean	87.5	78.1	80.0	75.0	79.2	83.3	73.3	80.8	79.0	79.8	79.5
Aggressively destroy weeds when found	90.0	91.4	76.5**	100.0**	95.8	92.3	80.0	93.8	86.4	93.8	90.8
Spot spray near fringe or boundary areas	100.0	97.0	50.0**	92.3**	77.3	76.9	57.1**	89.3**	69.6*	89.9*	82.1
Routinely check range for invading plants	88.9***	100.0***	93.8	100.0	92.3	100.0	100.0	96.6	94.0***	98.9***	96.9
Insist local governments control leafy spurge in road ways and ditches	71.4	91.4	73.3	75.0	73.1	58.3	66.7	57.1	71.4	71.9	71.7

Control Method or Practice	North Dakota		Montana		South Dakota		Wyoming		Total		Overall
	no	yes	no	yes	no	yes	no	yes	no	yes	
	----- % indicating method is very effective -----										
Spraying with herbicides	33.3	33.3	0.0	20.0	18.2**	53.9**	23.5*	28.1*	17.9***	33.7***	27.2
Biological control with insects and/or pathogens	44.4	31.0	0.0	0.0	23.5	50.0	0.0	18.5	15.4	23.0	19.8
Grazing with sheep or goats	30.0	20.0	41.2	38.5	26.3***	10.0***	25.0	14.3	30.7**	19.5**	24.5
Tillage & or reseeded	12.5	4.8	7.1	0.0	0.0	20.0	7.1	4.6	6.0	5.3	5.6

Control Method or Practice	North Dakota		Montana		South Dakota		Wyoming		Total		Overall
	no	yes	no	yes	no	yes	no	yes	no	yes	
	----- % indicating method is economical -----										
Spraying with herbicides	44.4	69.7	62.5	64.3	68.0	86.7	53.3**	84.4**	60.0***	77.1***	70.2
Biological control with insects and/or pathogens	62.5	63.3	64.3	50.0	73.3	100.0	73.3	61.5	69.2	64.4	66.4
Grazing with sheep or goats	10.0	31.8	82.4	69.2	54.6	60.0	73.3	58.3	59.4	52.9	56.0
Tillage & or reseeded	22.2	5.9	30.8	12.5	26.7	25.0	28.6	18.2	27.5	13.5	20.4

\* Statistically different at  $P \leq 0.01$  between those who have leafy spurge and those who do not within individual states (Chi-square test statistic).

\*\* Statistically different at  $P \leq 0.05$  between those who have leafy spurge and those who do not within individual states (Chi-square test statistic).

\*\*\* Statistically different at  $P \leq 0.10$  between those who have leafy spurge and those who do not within individual states (Chi-square test statistic).

Appendix Table B6. Ranchers Who Currently Have Leafy Spurge and Have Used Various Control Practices in Past or Expect to in Future, By State, 1998

Control Method	Used in Past				Total
	North Dakota	Montana	South Dakota	Wyoming	
	----- % indicating they have used method/practice-----				
Herbicides	96.3	100.0	100.0	96.0	97.1
Biological control ***	73.1	50.0	33.3	39.1	54.1
Sheep or goats **	16.7	71.4	42.9	26.1	29.5
Tillage &/or reseeding with competing grasses ***	13.6	50.0	0.0	13.0	15.8
	Expect to Use in Future				
	----- % indicating they expect to use method/practice-----				
Herbicides	100.0	100.0	100.0	100.0	100.0
Biological control **	64.3	62.5	0.0	61.1	54.4
Sheep or goats **	17.7	66.7	0.0	26.7	25.0
Tillage &/or reseeding with competing grasses	14.3	20.0	0.0	25.0	17.4

\*\* Statistically different at  $P \leq 0.05$  among states by each control method (Chi-square test statistic).

\*\*\* Statistically different at  $P \leq 0.10$  among states by each control method (Chi-square test statistic).

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# Appendix C

## Respondent Ranch Characteristics

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Appendix Table C1. Comparison of Site Counties' Land Area, Number of Ranches, Livestock Inventories, Leafy Spurge Acreage, Population, and Per Capita Income

Characteristic	Leafy Spurge ---- acreage ----	Land Area ---- acreage ---	---	
			%	
Acreage of Leafy Spurge:				
Billings County, ND	not available	736,980		
Golden Valley County, ND	30,500	641,280	4.8	
Carter County, MT	8,000	2,137,408	0.4	
Harding County, SD	720	1,709,184	0.0	
Crook County, WY	40,000	1,829,568	2.2	
	Total Farms(1992)	Farms with more than \$10,000 in sales	<u>Livestock Inventory (1992)</u>	
			Beef Cows	Sheep
Billings County, ND	242	192	16,393	834
Golden Valley County, ND	219	181	12,393	3,135
Carter County, MT	308	243	32,033	94,474
Harding County, SD	282	224	38,688	74,602
Crook County, WY	440	301	39,627	41,287
	Population (1995)	Per Capita Income (1995)		
Billings County, ND	1,157	17,411		
Golden Valley County, ND	1,962	15,252		
Carter County, MT	1,464	17,576		
Harding County, SD	1,542	21,012		
Crook County, WY	5,656	17,354		

Sources: Bangsund (1997), Bureau of Census (1996) (1994).