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Perceptions of Leafy Spurge by Ranch Operators and Local Decision Makers: An Update

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ABSTRACT

A survey of 476 ranchers and 45 local decision makers (LDM) (521 total) 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. The respondents represented a four-county region in Montana and North Dakota and are compared and contrasted to a group of ranchers and LDM from surrounding counties surveyed in 1998. The questionnaire focused on weed management in general and specifically on the perceptions and attitudes of ranchers and LDM who have been directly and indirectly affected by leafy spurge.

Overall, the updated survey results reveal that ranchers and LDM had fewer problems with all noxious weeds, including leafy spurge than those ranchers and LDM surveyed in 1998. These respondents were less likely to use, or had used, the various methods of control than the original survey group. However, the vast majority of respondents were concerned about controlling weeds on rangeland and viewed leafy spurge as a long-term management problem. The LDM were more likely to believe that the weed problem in their area was a major problem and that leafy spurge was the most important weed. More than one-half of all LDM were familiar with the origins of leafy spurge, how it negatively impacts rangeland, and how the most effective biological control agents acted to control leafy spurge. None of the LDM from the 1999 survey thought that biological control was effective in controlling leafy spurge and nearly 80 percent thought that grazing with sheep or goats would pay as a type of leafy spurge control.

A comparison of results with the earlier survey of ranchers indicates that financial constraints on weed control are prevalent. Also, the knowledge needed to adopt various treatment programs appears to be lacking. Education and awareness of biological control options would facilitate more adoption of biological agents to control leafy spurge. Likewise, assistance in obtaining equipment and knowledge of sheep/goat management would help in allowing many managers to use sheep and/or goats to curb further leafy spurge expansion.

Key Words: leafy spurge, weed management, rancher opinion, local decision maker opinion, North Dakota, Montana, noxious weeds.

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 four-county area in North Dakota (Bowman and Slope counties), and Montana (Fallon and Wibaux Counties) and represents an update to the same survey which was administered in 1998. A total of 521 ranch operators and local decision makers (LDM) were surveyed, and 177 completed questionnaires were obtained (34 %). This sample was intended to represent those producers and LDM who ranch, represent, or manage property within the study area. The survey focused on weed management in general and specifically on the perceptions and attitudes of ranchers and LDM, who may have been directly and indirectly affected by leafy spurge.

Leafy spurge was recognized as the most important weed problem for ranchers and LDM in the four-county area. However, ranchers and LDM in the 1999 survey area were less likely to indicate that weeds in general were a major problem for them or in their area than respondents to the 1998 survey. The percentage of ranchers in the 1999 survey who indicated having leafy spurge on their ranch was less than the 1998 survey, 41 percent versus 56 percent, respectively. Ranchers in the updated survey area had leafy spurge on approximately 2 percent of operated acreage.

Reasons for not using herbicides included environmental restrictions, inadequate funding, and too large of infestations. Biological control was often not used because the biological agents take too long to work, there was limited access to biological agents, and respondents did not know how to properly use agents. The main reason that ranchers and LDM did not use grazing as a control mechanism was that they did not have the equipment or expertise to include sheep in their grazing strategies. Other methods such as tillage, planting competing grasses, burning, and mowing were not used because land is not suitable for these methods.

Overall, a vast majority of the respondents were concerned about controlling weeds on rangeland and understood leafy spurge is a long-term management problem. The LDM were more likely than the ranchers to believe that the weed problem in their area was a major problem and that leafy spurge was the most important weed.

The results of this survey indicate that financial constraints on weed control are prevalent in both private and public land management. Also, the amount of knowledge needed to adopt various treatment programs appears to be lacking in both ranchers and LDM. Education and awareness on how to use and where to find biological controls would facilitate more adoption of biological agents to control leafy spurge. Likewise, assistance in obtaining equipment and knowledge of sheep/goat management might enable some managers to use sheep and/or goats to curb further leafy spurge expansion. Furthermore, it is very important to note that most ranchers and LDM get their information about weed management from the Extension Service and would like the information in the form of a bulletin or extension circular.

The TEAM Leafy Spurge project could enhance adoption of all leafy spurge control methods by addressing concerns exhibited by each of the groups surveyed. By facilitating cooperative efforts between managers of adjoining lands and by pooling resources, perhaps many of the hardships created by leafy spurge can be overcome.

PERCEPTIONS OF LEAFY SPURGE BY RANCH OPERATORS AND LOCAL DECISION MAKERS: AN UPDATE

Randall S. Sell, Dean A. Bangsund, and F. Larry Leistritz *

INTRODUCTION

Cost effective control of leafy spurge on rangeland (public and private), wildlands, and other public lands (roadways, historic sites, etc.) 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. In 1998, a survey of ranchers, local decision makers (LDM), and public land managers of grazing and non-grazing property was conducted to evaluate managerial, institutional, and social factors that may affect the rate and extent of implementation of various control strategies based upon respondents' perspectives (Sell et al. 1998a, Sell et al. 1998b). The ranchers and LDM were in 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). This report represents an expansion of the original survey's geographical coverage by including four additional counties, Bowman and Slope Counties in North Dakota, and Fallon and Wibaux Counties in Montana.

METHODS

The goal in selecting the group of LDM was to solicit perspectives and opinions of individuals who were in a position to make or influence decisions about, or relating to, control of leafy spurge and other weeds. A list of ranchers whose mailing address was in the four counties was obtained from Intertec Publishing (1999). The survey pool of LDM included state legislators, county agents, county commissioners, county weed board members, and township board members. LDM were included in the potential survey pool if part of their district was within or included the additional four counties and they had not been included in the original four counties survey pool.

The individuals in the rancher and LDM survey pools were mailed the first questionnaire and cover letter in January 1999; one follow-up questionnaire and cover letter was mailed three weeks later to nonrespondents. The response rate for ranchers and LDM was 33 and 49 percent, respectively (Table 1).

* Sell and Bangsund are research scientists and Leistritz is a professor at Department of Agricultural Economics, North Dakota State University, Fargo.

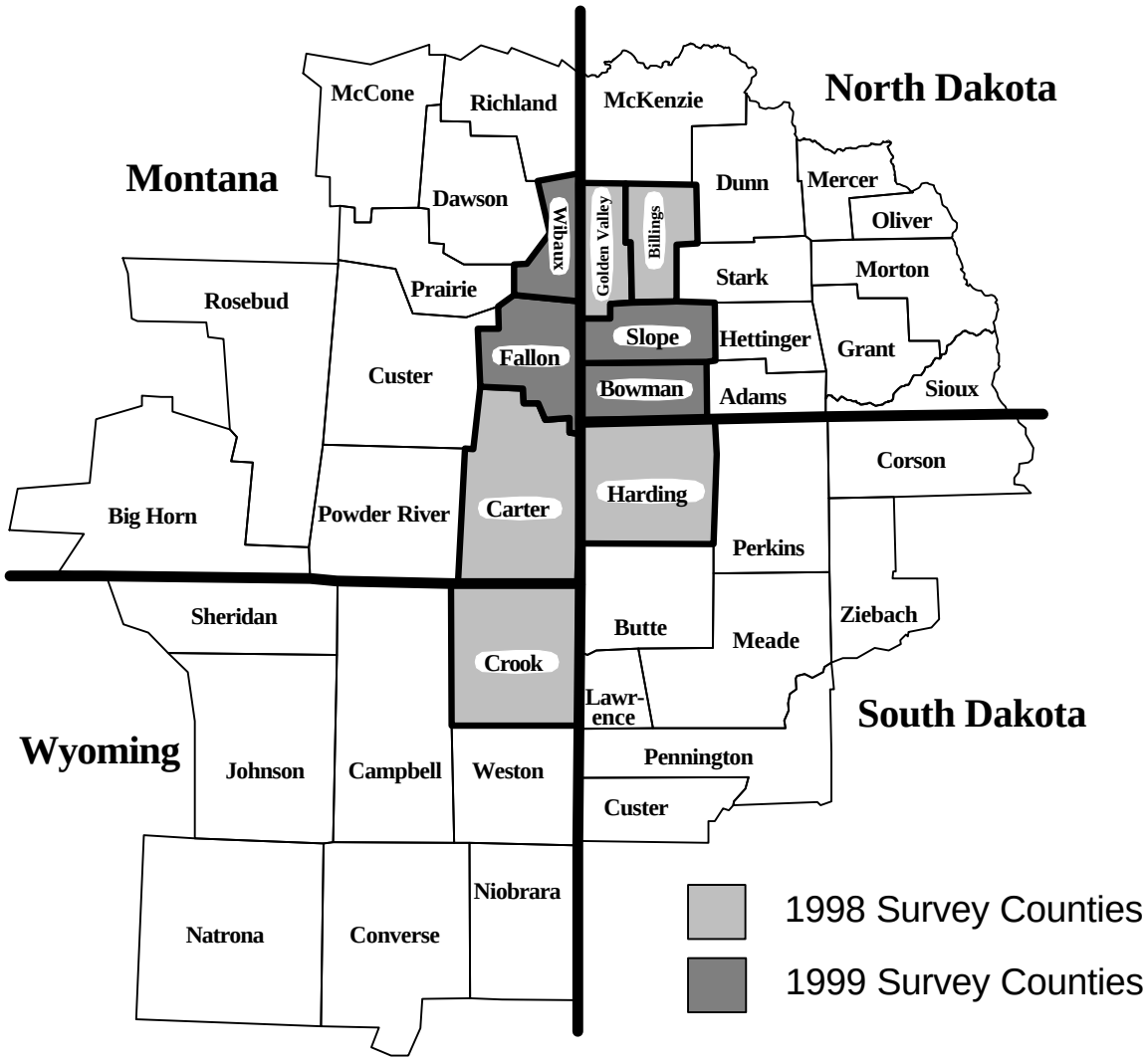

Figure 1. Study Counties for Perceptions of Leafy Spurge by Ranchers and Local Decision Makers, 1998 and 1999

RESULTS

The primary focus of the analysis presented within this report is comparative in nature between the ranchers and LDM surveyed in 1998 and 1999.

Characteristics of Respondents

The average age and education of ranchers and LDM was similar to the previous survey. The percentage of ranchers who reported having leafy spurge on their ranch was lower in the updated survey area, 41 percent versus 56 percent. Also, the ranchers in the updated survey operated about one-third fewer acres, and for those who reported having leafy spurge infestations, the infestation rate was about one-half of the original survey group.

Table 1. Characteristics of Respondents to Weed Management Survey, 1999

Characteristic	Unit	Value
Response rates:		
1998 Ranchers	percent	40.7
sample [1]		(187)
1998 LDM	percent	67.9
sample		(38)
1999 Ranchers	percent	32.6
sample		(155)
1999 LDM	percent	48.9
sample		(22)
Age:		
1998 Ranchers	years	53
1998 LDM	"	51
1999 Ranchers	"	52
1999 LDM	"	51
Education (percent with college degree):		
1998 Ranchers	percent	43.7
1998 LDM	"	43.2
1999 Ranchers	"	43.3
1999 LDM	"	40.9
Average acreage operated (per respondent):		
1998 Ranchers	acres	6,912
sample		(187)
1999 Ranchers	acres	4,450
sample		(155)
Currently have leafy spurge on ranch:		
1998 Ranchers	percent	55.6
sample		(180)
1999 Ranchers	percent	41.3
sample		(138)
Average acreage infested with leafy spurge: [2]		
1998 Ranchers	percent	3.9
sample		(83)
1999 Ranchers	percent	1.6
sample		(37)

[1] Designates the number of respondents completing that question.

[2] Average acreage of infestation reported only for those respondents who reported acreage of leafy spurge on grazing land, hay land, and other public land (i.e., some respondents reported currently having leafy spurge but did not give the acreage of infestation).

Problems Faced by Ranchers and LDM

Respondents were asked to rate several grazing and weed management issues as *major* problems, *not* a problem, or *minor* problems. Ranchers and LDM in the 1999 survey were more likely to believe that livestock prices were a *major* problem and less likely to respond that predators and noxious weeds were *major* problems than the 1998 survey respondents (Table 2). Exempting the 'other' category, LDM most often believed that livestock prices (87 %) were a *major* problem, which was also the ranchers' leading *major* problem category. LDM were much more likely than ranchers to respond that noxious or invasive weeds were a *major* problem.

When asked to indicate which of the issues listed was the single *most* important, livestock prices were again indicated as the *most* important problem both overall and by each group. Less than 5 percent of 1999 ranchers indicated that noxious and invasive weeds were the *most* important problem. The 1999 group of ranchers and LDM were much less likely to indicate that noxious weeds had become worse in the past five years than the 1998 groups. However, more than 50 percent of LDM in both survey groups felt that noxious weeds had become worse in the past five years.

Table 2. Problems Faced by Ranchers and Local Decision Makers in the Past Five Years, 1999

	Ranchers			Local Decision Makers		
Problems/Issues	1998	1999	Overall	1998	1999	Overall
	---------- % indicated a *major* problem ----------					
Livestock prices [a*]	78.7	95.1	85.9	86.5	85.7	86.2
Adverse weather conditions	62.5	60.0	61.4	51.4	52.4	51.7
Cost of feed and supplies	52.8	56.3	54.3	62.2	47.6	56.9
Regulations affecting use of public lands	34.1	34.7	34.3	47.2	40.0	44.6
Availability of grazing land	26.3	29.1	27.5	24.3	28.0	25.9
Predators [a* c***]	36.3	13.9	26.3	46.0	25.0	38.6
Noxious or invasive weeds [a * c*]	30.8	14.9	23.8	58.3	52.4	56.1
Use of CRP for haying and grazing	13.6	14.6	14.1	8.6	9.5	8.9
Others [1]	68.4	60.0	65.5	100.0	100.0	100.0
	----- % indicated *most* important problem -----					
Livestock prices	32.0	52.2	40.9	37.9	55.6	44.7
Adverse weather conditions	24.4	22.8	23.7	24.1	5.6	17.0
Cost of feed and supplies	9.9	5.9	8.1	3.5	5.6	4.3
Regulations affecting use of public lands	8.1	7.4	7.8	10.3	22.2	14.9
Availability of grazing land	7.6	5.2	6.5	3.5	0.0	2.1
Noxious or invasive weeds	8.1	3.7	6.2	10.3	5.6	8.5
Predators	5.8	2.2	4.2	6.9	0.0	4.3
Others	2.9	0.7	2.0	3.5	0.0	2.1
Use of CRP for haying and grazing [a**]	1.2	0.0	0.7	0.0	5.6	2.1
	-- % indicated problem became worse in past 5 years --					
Livestock prices [a*]	67.0	93.8	78.8	81.1	90.5	84.5
Cost of feed and supplies [a** b***]	64.8	52.8	59.6	81.1	52.4	70.7
Regulations affecting use of public lands	53.7	54.6	54.1	58.8	70.0	63.0
Predators [a*]	46.6	24.3	36.8	44.4	50.0	46.4
Noxious or invasive weeds [a* b*** c**]	42.0	27.9	35.8	66.7	36.4	55.2
Availability of grazing land	35.8	25.5	31.3	22.9	14.3	19.6
Adverse weather conditions [a** c*]	26.1	14.0	20.8	8.3	9.5	8.8
Use of CRP for haying and grazing [a***]	9.8	18.9	14.2	6.3	19.1	11.3
Others [2]	50.0	60.0	52.6	50.0	0.0	50.0

[1] Other problems mentioned by ranchers was grasshoppers. The LDM mentioned the big difference in the quality and quantity of rangeland and pasture.

[2] Ranchers thought that grasshoppers and high cost of ag. land were other problems which had gotten worse in the past five years, while the LDM felt that the big difference in the quality and quantity of rangeland and pasture, and absentee landowners were problems which had gotten worse.

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

* Statistically different at P <=0.01 (Chi-square test statistic).

** Statistically different at P <=0.05 (Chi-square test statistic).

*** Statistically different at P <=0.10 (Chi-square test statistic).

Weed Species and Management Problems

Weeds other than leafy spurge pose problems to ranchers and public land managers. Some of those weeds specifically listed in the questionnaire included: field bindweed, thistles, annual bromegrass, sagebrush, knapweeds, prickly pear, and absinth wormwood. Across all groups, the weed most often indicated as a problem by the respondents was leafy spurge (Table 3). However, LDM were much more likely than ranchers to indicate that leafy spurge was a *major* problem. Less than one-third of ranchers in the 1999 survey indicated that leafy spurge was a major problem. The percentage of ranchers and LDM in the 1999 survey who felt leafy spurge was their most important weed also declined, although the decline was less for the LDM.

Opinions varied on how invasive weeds spread in the area. Although the percentage of ranchers who indicated 'infestation spread from adjoining land' declined from the 1998 survey group, it was the most often indicated reason of how leafy spurge spread (Table 4).

When ranchers were asked to indicate how serious they felt weed problems were on their ranch, less than 15 percent indicated weeds were a *major* problem, while nearly 25 percent overall responded weeds were *not a* problem (Table 5). LDM were much more likely to indicate weeds were a problem in their area. About 60 percent of LDM overall thought weeds in their area were a *major* problem. Fewer ranchers and LDM in the 1999 survey felt that weeds on their ranch, or in their area, were a major problem than those surveyed in 1998.

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 statements with which all ranchers most strongly agreed (average score closest to 5 - strongly agree) was 'I am concerned about controlling weeds in rangeland' (overall average score 4.7) (Table 6). Alternatively, ranchers and LDM disagreed with the statement 'weed infestations have no effect on the market value of rangeland.' LDM indicated that local governments are doing enough to help control problem weeds on private grazing land; ranchers tended to disagree.

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. Less than 50 percent of all respondents indicated that spraying with herbicides was 'very effective'; however, more than 60 percent of all groups thought 'it pays' to spray leafy spurge with herbicides (Table 7). While many respondents did not indicate herbicides are 'very effective' at controlling leafy spurge, herbicide use is perceived as being better than not attempting any control of the infestations. A greater share of 1999 ranchers indicated grazing with sheep or goats was 'very effective.' Alternatively, no 1999 LDM indicated that biocontrol was 'very effective.' More than 75 percent of 1999 LDM responded 'it pays' to graze sheep or goats.

Only the ranchers were asked whether they used several preventative measures to thwart establishment or expansion of leafy spurge on their property. More than 95 percent routinely checked their land for invading plants (Table 8). Nearly 95 percent aggressively destroyed weeds when found. A lower proportion of the 1999 ranchers had used any of the control methods in the past or expect to use them in the future compared to 1998 respondents.

Ranchers were asked to indicate the reasons for not using these four main control methods. Nearly 60 percent of the ranchers indicated that 'environmental restrictions' was the main reason for not using herbicide treatments (Table 9). However, within the LDM group, the greatest share of respondents (76 %) indicated 'acreage of infestations were too large' as the most common reason for not using herbicides. Overall, the most common reasons for not using biological agents were 'limited access to agents' and 'take too long to work.' An important reason to more than 50 percent of the LDM was that they did not know how to properly use biological agents. Nearly 75 percent of all ranchers and 85 percent of LDM indicated that not having the right type of equipment was the most important reason for not using sheep and goats, although the second most often listed reason for both groups was a lack of expertise with sheep or goats. The most common reason for not using other methods of control (i.e., tillage, planting competing grasses, burning, mowing) across all respondents was that land was not suitable for tillage.

Table 3. Weeds Posing Greatest Problems to Ranchers and Local Decision Makers, 1999

	Ranchers			Local Decision Makers		
Weeds	1998	1999	Overall	1998	1999	Overall
	---------- % indicated a *major* problem ----------					
Leafy spurge [a* b** c*]	49.4	31.7	41.6	86.8	59.1	76.7
Field bindweed	25.0	24.4	24.8	19.4	9.1	15.5
Thistles	25.3	16.3	21.4	37.8	13.6	28.8
Annual brome grasses [a**]	13.3	8.1	10.9	15.2	4.8	11.1
Sagebrush	8.1	12.2	9.9	11.1	0.0	6.9
Knapweeds [a*]	6.3	5.4	5.9	5.9	0.0	3.6
Prickly pear	5.2	6.1	5.6	3.1	4.8	3.8
Wormwood (absinth)	0.0	1.0	0.5	4.6	0.0	2.6
Others [c*** 1]	65.7	58.3	62.7	0.0	0.0	0.0
	---------% indicated *most* important problem [a* c*] ------					
Leafy spurge	59.8	43.0	50.8	90.9	85.7	88.9
Thistles	11.2	15.6	13.1	3.0	9.5	5.6
Sagebrush	7.1	17.2	11.5	0.0	0.0	0.0
Others	9.5	7.0	8.4	0.0	4.8	1.9
Annual brome grasses	8.3	3.9	6.4	3.0	0.0	1.9
Field bindweed	4.7	3.1	4.0	0.0	0.0	0.0
Knapweeds	1.8	4.7	3.0	0.0	0.0	0.0
Prickly pear	0.6	4.7	2.4	3.0	0.0	1.8
Wormwood (absinth)	0.0	0.8	0.3	0.0	0.0	0.0

[1] Other weeds listed included the following: hounds tongue, field pennycress, cheatgrass, burdock, Canada thistle, sandburs/cockleburs, tansy, ragweed, fringed sage, locoweed, smooth bromegrass, quackgrass, poison plants, Dalmatian toadflax, and crested wheatgrass.

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

* Statistically different at P <=0.01 (Chi-square test statistic).

** Statistically different at P <=0.05 (Chi-square test statistic).

*** Statistically different at P <=0.10 (Chi-square test statistic).

Table 4. Percentage of Respondents Indicating the Manner in Which Leafy Spurge Infestations Expanded, 1999

Methods of Spreading	Ranchers 1998	Ranchers 1999	Ranchers Overall	Local Decision Makers 1998	Local Decision Makers 1999	Local Decision Makers Overall
	------ % indicated two *most* important problems -----					
Infestation spread from adjoining land [a*]	63.3	46.7	56.2	60.5	71.4	64.4
Not recognized as a problem/ threat until its too late	41.7	38.0	40.1	50.0	47.6	49.2
Spread by man's actions (e.g., vehicles, contaminated hay)	28.9	35.8	31.9	23.7	30.0	25.9
Lack of cost effective controls	29.1	25.6	27.5	34.2	35.0	34.5
Overgrazing of rangeland [a*]	7.8	17.5	12.0	5.3	5.0	5.2
Other [1]	10.6	9.6	10.2	15.8	15.0	15.5
Lack of competition from native plants/grasses	4.5	6.6	5.4	5.3	5.0	5.2

[1] For those listing other reasons, 60 percent indicated spread by deer and birds, followed by 15 percent indicating lack of something to kill the invasive weed.

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

[*] Statistically different at P <=0.01 among all of respondents for each method of spreading (Chi-square test statistic).

Table 5. Respondents' Perceptions of the Seriousness of the Weed Problem on Their Ranch or in Their Area, 1999

Perception of Weed Problem [a* c*]	Ranchers 1998	Ranchers 1999	Ranchers Overall	Local Decision Makers 1998	Local Decision Makers 1999	Local Decision Makers Overall
	---------- % ----------					
Not a problem	16.9	28.4	22.0	2.6	0.0	1.7
Minor problem	65.7	68.7	67.0	31.6	50.0	38.3
Major problem	17.5	3.0	11.0	65.8	50.0	60.0

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

[*] Statistically different at P <=0.01 (Chi-square test statistic).

Table 6. Respondents' Opinions and Perceptions about Weed Management, Leafy Spurge Infestations, and Methods of Leafy Spurge Control, 1999

Statement	Ranchers			Local Decision Makers		
	1998	1999	Overall	1998	1999	Overall
	---------- average score [1] ----------					
I am concerned about controlling weeds in rangeland [a**]	4.8	4.6	4.7	NA	NA	NA
State and Federal government agencies are not doing enough to control problem weeds on public grazing land	4.5	4.4	4.5	4.3	4.7	4.4
Rangeland weeds represent a problem to all ranchers [a**]	4.4	4.1	4.2	4.2	4.2	4.3
There needs to be more research on controlling weeds in rangeland	4.0	4.1	4.0	4.0	3.7	3.9
Herbicides, if used properly, are not harmful to the environment [c**]	4.0	3.8	3.9	4.2	4.3	4.3
State and Federal government agencies are not doing enough to help control problem weeds on private grazing land	3.7	3.7	3.7	3.7	3.9	3.8
Restrictions affecting the use of herbicides on rangeland are too strict	3.6	3.4	3.5	3.3	3.7	3.5
Local governments are not effective in controlling problem weeds [c*]	3.4	3.2	3.3	2.8	2.6	2.7
Weed problems in rangeland are generally the result of poor range management	3.2	3.3	3.3	3.4	3.0	3.2
It doesn't pay to control weeds on my land when my neighbor doesn't control his weeds	2.7	2.7	2.7	NA	NA	NA
Public land managers are doing a good job of controlling weeds on public land [a**]	1.7	2.1	1.9	1.9	1.8	1.9
It seldom makes economic sense to control weeds on rangeland [c*]	1.9	1.8	1.8	1.4	1.1	1.3
Weeds infestations have no effect on the market (sale) value of rangeland	1.7	1.7	1.7	1.4	1.5	1.4

– continued --

Table 6. Continued

Statement	Ranchers			Local Decision Makers		
	1998	1999	Overall	1998	1999	Overall
	---------- average score [1] ----------					
Leafy spurge is a long-term management problem	4.6	4.7	4.7	4.7	4.8	4.8
The expected payoff from biological control of leafy spurge justifies investment of public funds to develop the process	4.2	4.2	4.2	4.4	4.2	4.3
Biological agents released to control leafy spurge are safe for crops and native plants	4.2	4.2	4.2	4.3	4.6	4.4
Governments should help pay part of the cost to control leafy spurge, even if it means an increase in taxes	3.5	3.5	3.5	3.7	3.7	3.7
Leafy spurge can be controlled but it is just too costly	3.2	3.1	3.1	3.0	3.0	3.0
Biological control will eventually eliminate the leafy spurge problem	2.8	3.0	2.8	2.9	2.2	2.7
Leafy spurge is virtually impossible to control with current control methods and techniques	2.7	2.6	2.7	2.4	2.3	2.4
Leafy spurge negatively affects various agency's ability to effectively manage their land [b**]	NA	NA	NA	4.2	3.8	4.1

NA means that question was not posed to that survey group.

[1] Based on a score of 1 to 5, where 1 is strongly disagree and 5 is strongly agree.

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

[*] Statistically different at P <=0.01 (T-test).

[**] Statistically different at P <=0.05 (T-test).

Table 7. Respondents' Belief in Most Effective and Economical Methods to Control Leafy Spurge, 1999

	Ranchers			Local Decision Makers		
Control Methods	1998	1999	Overall	1998	1999	Overall
Effectiveness of these practices in controlling leafy spurge	---------- % indicated *very* effective ----------					
Spraying with herbicide	27.3	26.2	26.8	31.4	27.3	29.8
Biological control with insects or pathogens [b*]	20.3	20.0	20.2	22.9	0.0	14.3
Grazing with sheep or goats [a**]	23.9	28.4	25.8	30.3	28.6	29.6
Tillage &/or reseeding	5.6	6.0	5.7	4.0	0.0	2.6
Economical to use these practices in controlling leafy spurge	---------- % indicating "it pays" ----------					
Spraying with herbicide	70.1	70.9	70.4	60.5	81.8	68.3
Biological control with insects or pathogens	65.9	58.5	62.8	61.1	57.1	59.7
Grazing with sheep or goats	56.0	55.6	55.8	54.5	77.3	63.6
Tillage &/or reseeding	19.8	28.2	23.2	4.4	25.0	12.8

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

[*] Statistically different at P <=0.01 (Chi-square test statistic).

[**] Statistically different at P <=0.05 (Chi-square test statistic).

Table 8. Respondents Use of Preventative Practices and Control Measures in Past and Future, 1999

Preventative Practices	Ranchers		
	1998	1999	Overall
	-- % indicated they use the following practices --		
Routinely check range for invading plants	96.9	96.8	96.8
Aggressively destroy weeds when found	91.0	95.0	92.7
Keep machinery/trucks clean	79.7	86.5	82.5
Spot spraying near fringe or boundary areas ***	82.3	73.5	78.7
Insist that local governments control leafy spurge in road ways and ditches	72.1	79.1	75.0
Purchase only weed-free hay	71.2	79.2	74.4
Other measures [1]	68.2	80.0	71.9
Used the following controls in the past			
Herbicides	97.2	97.7	97.4
Biological control **	54.0	37.2	47.2
Sheep or goats	30.2	19.1	25.7
Tillage and/or reseeding with competing grasses	15.3	10.3	13.3
Expect to use the following controls in the future			
Herbicides	100.0	97.0	98.9
Biological control	54.2	46.7	51.3
Sheep or goats	26.1	12.9	20.8
Tillage and/or reseeding with competing grasses	16.7	11.1	14.7

[1] Overall other measures include; grazing, biocontrol, and control neighbors spots.
** Statistically different at P <=0.05 among all groups of respondents (Chi-square test statistic).
*** Statistically different at P <=0.10 among all groups of respondents (Chi-square test statistic).

Table 9. Based Upon What Respondents Experienced, Believed, or Had Been Told, Their Indication of Why the Following Controls Are Not Used on Leafy Spurge, 1999

Reasons for Not Using Controls	Ranchers			Local Decision Makers		
	1998	1999	Overall	1998	1999	Overall
Reasons for not using herbicide treatments	------ % indicated reason for not using ------					
Environmental restrictions/concerns prevent me from applying herbicides (such as, spraying near water, trees, sensitive crops, etc.)	61.7	55.4	58.9	66.7	63.6	65.5
Acreage of infestations is so large that the cost of using herbicides would be prohibitively expensive [a** c*]	51.8	39.3	46.3	77.8	72.7	75.9
Leafy spurge infestations are inaccessible to sprayers	41.8	50.9	45.9	47.2	54.6	50.0
Herbicides are not economical	45.4	41.1	43.5	42.7	40.9	41.4
Cost-share programs for herbicides are no longer available or have been reduced	33.3	26.8	30.4	NA	NA	NA
Do not have the time to treat the leafy spurge infestations [c***]	29.8	23.2	26.9	38.9	40.9	39.7
Herbicides are ineffective in controlling leafy spurge [b***]	24.8	25.9	25.3	27.8	9.1	20.7
Lack the equipment or expertise to apply herbicides (such as restricted use permits) [a**]	18.4	31.3	24.1	25.0	18.2	22.4
Others reasons [1]	2.1	1.8	2.0	5.6	4.6	5.2
Most people/agencies lack funding to efficiently manage leafy spurge	NA	NA	NA	63.9	63.6	63.8
Damage to non-target species [b***]	NA	NA	NA	30.6	9.1	22.4
Reasons for not using biological controls						
Limited access to biological agents (cannot collect sufficient numbers of the agents) [c***]	45.1	41.2	43.3	60.0	52.6	57.1
Biological agents take too long to work [a***]	47.8	36.1	42.4	46.7	68.4	55.1
Do not know how to obtain or where to obtain the insects [c**]	34.5	27.8	31.4	36.7	63.2	46.9
Do not know how to properly use the agents [c*]	30.1	28.9	29.5	53.3	57.9	55.1
Do not have the time to work with biological agents	23.9	15.5	20.0	20.0	26.3	22.5
Biological agents will not likely work on my leafy spurge infestations	18.6	11.3	15.2	16.7	5.3	12.2
Afraid the agents will spread or attack other plants	16.8	12.4	14.8	6.7	15.8	10.2
Biological agents are not economical	10.6	10.3	10.5	3.3	5.3	4.1
Biological agents will eventually spread to my leafy spurge without my help [a***]	7.1	2.1	4.8	3.3	15.8	8.2
Other reasons [2]	1.8	5.2	3.3	0.0	0.0	0.0

- continued -

Table 9. continued

Reasons for Not Using Controls	Ranchers 1998	Ranchers 1999	Ranchers Overall	Local Decision Makers 1998	Local Decision Makers 1999	Local Decision Makers Overall
	------ % indicated reason for not using ------					
Reasons for not using sheep &/or goats						
Do not have the right equipment (fences, water, shelter) for sheep and goats [c***]	71.3	73.3	72.2	83.3	85.7	84.2
Do not have the expertise/knowledge to work with sheep and goats	41.0	42.6	41.7	41.7	57.1	47.4
Sheep and goats are too time consuming to use	39.3	40.6	39.9	33.3	33.3	33.3
Sheep and goats will compete with cattle for the same forage [a**]	43.4	29.7	37.2	NA	NA	NA
I do not like sheep or goats	36.1	35.6	35.9	NA	NA	NA
Sheep and goats are too costly to manage/ not economical to use	23.0	18.8	21.1	11.1	19.1	14.0
Sheep and goats are ineffective in controlling leafy spurge	25.4	11.9	19.3	13.9	14.3	14.0
Other reasons [3] [b***]	13.1	12.9	13.0	22.2	4.8	15.8
Sheep and goats will negatively affect non-target species	NA	NA	NA	25.0	19.1	22.8
Various agency's policies prevent using sheep or goats [b**]	NA	NA	NA	11.1	33.3	19.3
Reasons for not using other control methods						
Land is not suitable for tillage (inaccessible, incompatible terrain, light soil, too rocky, etc.) [c*]	84.7	80.9	83.1	97.2	95.5	96.6
These methods are ineffective	36.0	35.4	35.8	36.1	40.9	37.9
Do not have enough time to work with those methods [b**]	26.7	23.6	25.4	25.0	50.0	34.5
Lack the proper equipment [c*]	24.0	23.6	23.9	44.4	45.5	44.8
Do not know how to use these methods	21.3	20.0	20.8	25.0	36.4	29.3
Other reasons [4]	4.0	1.8	3.1	8.3	0.0	5.2
Damage to non-target species	NA	NA	NA	19.4	18.2	19.0
Various agency's policies prevent using these alternative methods	NA	NA	NA	30.6	18.2	25.9

NA means that survey group was not asked that question.

[1] Other reasons listed include: too lazy to apply herbicides, too much leafy spurge, and federal land not funded for spraying.

[2] Other reasons listed include: bugs too small to sustain a population and works great.

[3] Other reasons listed include: too many coyotes/ predators and not enough leafy spurge.

[4] Other reasons listed include: tilling stirs seeds and enhances spreading, too much brush and timber, and burning sets grass back too far.

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

[*] Statistically different at P <=0.01 (Chi-square test statistic).

[**] Statistically different at P <=0.05 (Chi-square test statistic).

[***] Statistically different at P <=0.10 (Chi-square test statistic).

Weed Management Information and Knowledge Base

The Extension Service and county weed boards were major sources of weed management information to all respondents, ranchers to a lesser degree than LDM (Table 10). The LDM in the 1999 survey group were more likely to use their county weed board than any other information source.

Types of information wanted most by respondents were effectiveness and economics of various herbicide treatment programs (Table 11). The form in which most respondents wanted information varied by group. The most desired form for the ranchers was a pamphlet or bulletin available through the local Extension Service office (46 %), while area demonstration plots were favored by LDM (71 %).

LDM were asked a series of questions about leafy spurge to determine the level of familiarity and knowledge of the invasive weed. Some of the questions were general while others were very specific and would probably require more than just a slight familiarity with the weed. All but one of the LDM (98 %) correctly answered the question, 'leafy spurge negatively affects rangeland output by?' (Table 12). Only one (2 %) correctly answered the question, 'leafy spurge can be eradicated using which method of control?' There was no statistical difference between percentage of correct answers of the LDM surveyed in 1998 and 1999.

Table 10. Sources of Weed Management Information Most Often Used By Respondents, 1999

Sources of Weed Management Information	Ranchers			Local Decision Makers		
	1998	1999	Overall	1998	1999	Overall
	------ % indicated used frequently -----					
Extension service/county agent/ universities [c*]	47.2	46.3	46.8	71.1	86.4	76.7
County weed board/officers [b** c*]	45.9	44.9	45.5	62.2	90.9	72.9
Other ranchers/neighbors	42.4	37.3	40.2	NA	NA	NA
Farm/ranch/trade magazines	25.9	20.0	23.4	24.2	9.1	18.2
Private companies/ consultants [b*** c*]	13.9	19.3	16.3	25.0	10.0	19.2
Grazing associations [c*]	12.6	13.8	13.1	21.2	0.0	13.0
Government agencies [c**]	11.7	9.7	10.9	6.3	0.0	6.3
Internet/On-line computer services/DTN [a** c*]	4.1	1.8	3.1	0.0	0.0	0.0
Public land managers (BLM, Forest Service) [c*]	4.0	1.8	3.0	6.1	4.8	5.6
Professional meetings/associations	NA	NA	NA	23.5	25.0	24.1
Other [1]	21.4	28.6	25.0	0.0	0.0	0.0
	------- % indicated *most* important source [c*]-------					
Extension service/county agent/ universities	37.7	46.8	41.6	62.9	68.4	64.8
County weed board/officers	31.2	26.2	29.1	31.4	15.8	25.9
Other ranchers/neighbors	11.2	12.7	11.8	NA	NA	NA
Private companies/consultants	6.5	4.8	5.7	2.9	0.0	1.9
Farm/ranch/trade magazines	5.3	3.2	4.4	0.0	0.0	0.0
Grazing associations	3.5	4.8	4.1	0.0	0.0	0.0
Other	1.8	1.6	1.7	0.0	0.0	0.0
Government agencies	2.4	0	1.4	0.0	0.0	0.0
Public land managers (BLM, Forest Service)	0.6	0.0	0.3	0.0	5.3	1.9
Internet/On-line computer services/ DTN	0.0	0.0	0.0	0.0	0.0	0.0
Professional meetings/associations	NA	NA	NA	2.9	10.5	5.6

[1] Other sources indicated were: ranchers that are treating, common sense, weed control seminars, and herbicide dealers.

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

[*] Statistically different at P <=0.01 (Chi-square test statistic).

[**] Statistically different at P <=0.05 (Chi-square test statistic).

[***] Statistically different at P <=0.10 (Chi-square test statistic).

Table 11. Types of Weed Management Information Most Wanted By Respondents, 1999

Type of Information	Ranchers			Local Decision Makers		
	1998	1999	Overall	1998	1999	Overall
	------ % indicated very interested -----					
Effectiveness of various herbicide treatment programs [a*** c*]	45.9	46.7	46.2	80.6	77.3	79.3
Economics of herbicide treatments [c*]	43.8	46.2	44.8	75.0	77.3	75.9
Economics of biological control [c*]	39.6	29.3	35.2	59.4	60.0	59.6
How to get started with biological control [a*** c*]	38.0	24.3	32.3	45.7	61.9	53.5
Economics of using sheep and goats [c*]	23.4	17.9	21.1	27.0	31.8	28.8
Techniques and effectiveness of control using sheep and goats [c*]	21.8	15.2	19.0	27.0	27.3	27.1
Economics of cultivation and reseeding [b***]	13.0	19.3	15.7	14.3	14.3	14.3
Techniques and effectiveness of cultivation and reseeding	13.6	17.0	15.0	13.9	14.3	14.0
Others [1]	13.3	0.0	9.5	100.0	0.0	100.0
Form of Information						
Pamphlet or bulletin available through Extension office or county agent	48.0	42.0	45.6	34.3	57.1	42.9
Testimonials from fellow ranchers and other land managers	40.1	36.4	38.6	62.2	61.9	62.1
Area demonstration plots showing the effectiveness of various control methods [c*]	38.3	37.3	37.9	71.1	71.0	71.2
Video cassettes demonstrating the various control methods	36.5	29.2	33.5	28.6	36.8	31.5
Personal visits and on-site help by range management specialists	31.9	34.5	33.0	47.4	76.2	57.6
Computer decision aids (programs) that can be used by ranchers/farmers to evaluate the feasibility or economics of various controls	12.2	12.5	12.3	5.9	10.0	7.4
Others [2]	30.8	33.3	31.6	0.0	0.0	0.0

[1] Other types of information indicated was desire to know the long term effect of various controls, pest management, new biocontrol agents, effects of cattle grazing/trampling, and mapping techniques.

[2] Other forms of information specified included: at my request, and license renewal seminars, books, and World Wide Web.

Note: 'a' signifies statistical difference between ranchers surveyed in 1998 and 1999, a 'b' signifies statistical difference between LDM surveyed in 1998 and 1999, and a 'c' signifies a statistical difference between ranchers and LDM overall.

* Statistically different at P <=0.01 (Chi-square test statistic).

*** Statistically different at P <=0.10 (Chi-square test statistic).

Table 12. Local Decision Makers' Knowledge About Leafy Spurge, 1999

	1998 LDM	1999 LDM	Overall	Answer
	-------- % correct --------			
Leafy spurge negatively affects rangeland output by?	97.4	100.0	98.3	*Reducing available forage*
Leafy spurge originally came from?	84.2	86.4	85.0	*Europe*
How do the most effective biological agents (insects) predominately control leafy spurge?	64.5	68.2	66.0	*Larvae destroy the root systems of plant*
Which U.S. state has the biggest leafy spurge problem (most acres infested)?	34.2	54.6	41.7	*North Dakota*
Which agency is responsible for screening biocontrol agents to ensure that they will not produce harmful effects on crops or native plants?	41.7	38.1	40.4	*Animal & Plant Health Inspection Service (APHIS)*
Leafy spurge can be eradicated using which method of control?	2.7	0.0	1.7	*Repeated tillage*

	Number of Correct Answers						
	Six	Five	Four	Three	Two	One	Zero
Percentage 1998	0.0	10.5	31.6	31.6	10.5	15.8	0.0
Percentage 1999	0.0	13.6	40.9	27.3	13.6	4.6	0.0

CONCLUSIONS AND IMPLICATIONS

Leafy spurge is a problem for ranchers and local decision makers (LDM), as evidenced by more than 50 percent who said it was their *most* important weed problem. All of the survey groups thought that livestock prices were the most important problem currently facing themselves and ranchers in their area.

Ranchers and LDM indicated concern about controlling weeds in rangeland and that leafy spurge was a long-term management problem.

The most often mentioned reason by ranchers for not using herbicides was environmental restrictions and for LDM the reason was too large of infestations. The most frequently indicated impediments for using biological control by LDM was limited access to biological agents, the biological agents take too long to work, and don't know how to properly use biological agents. The main reason that ranchers and LDM did not use grazing as a control mechanism was that they lacked the equipment and expertise to include sheep in their grazing strategies.

The type of information most wanted by respondents was the effectiveness and economics of various herbicide treatment programs. The most desired form of information for the ranchers was a pamphlet or bulletin available through the Extension Service. Area demonstration plots were the most important form of information to LDM. The most important source of information about weed management for ranchers and LDM was the Extension Service.

Overall, the updated survey results reveal that ranchers and LDM in the four-county area have fewer problems with all noxious weeds, including leafy spurge than those ranchers and LDM surveyed in 1998. These respondents are less likely to use, or have used, the various methods of control than the original survey group. The LDM were more likely to believe that the weed problem in their area was a major problem and that leafy spurge was the most important weed. More than one-half of all LDM were familiar with the origins of leafy spurge, how it negatively impacts rangeland, and how the most effective biological control agents acted to control leafy spurge. None of the LDM from the 1999 survey thought that biological control was effective in controlling leafy spurge and nearly 80 percent thought that grazing with sheep or goats would pay as a type of leafy spurge control.

A comparison of results with the earlier survey of ranchers indicates that financial constraints on weed control are prevalent. Also, the knowledge needed to adopt various treatment programs appears to be lacking. Education and awareness of biological control options would facilitate more adoption of biological agents to control leafy spurge. Likewise, assistance in obtaining equipment and knowledge of sheep/goat management would help in allowing many managers to use sheep and/or goats to curb further leafy spurge expansion.

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