

Assessing the Economic Impact of Noxious Weeds: The Case of Leafy Spurge

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Background

- Leafy spurge is an exotic, noxious, perennial weed that is widely established in the upper Great Plains
- Primarily a problem on untilled lands (rangeland, road ditches, parks, shelterbelts, wildlife production areas/refuges)
- Difficult to control and nearly impossible to eradicate
- From 1950 through 1980, leafy spurge infestations were doubling in North Dakota every 10 years. During the same period, other states also reported substantial infestations.

For those of you who are familiar with leafy spurge, you fully understand how dangerous this weed is. For those of you who are not that familiar with the weed, it can be very difficult to manage or contain.

Background

- In the late 1980s, state/federal researchers and policymakers started questioning how much resources should be used to develop viable control methods. At that time there were:
 - sizeable amounts of land infested with leafy spurge
 - concern over the future impact of allowing further spread
 - apparent ineffectiveness of traditional control methods to combat the weed
- In 1989, the Department of Agricultural Economics at NDSU started assessing the economic impacts of leafy spurge

Background

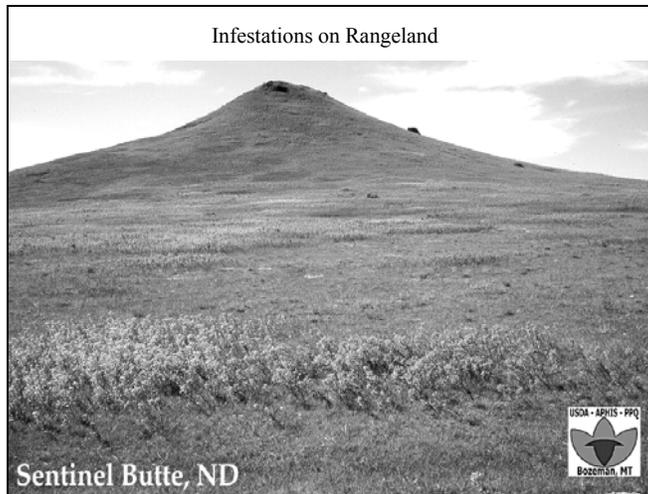
- Studies were largely funded by USDA-Animal and Plant Health Inspection Service (APHIS) and USDA-Agricultural Research Service (ARS) (Federal funds)
- Purpose of the research was to demonstrate and quantify the seriousness of the leafy spurge problem in North Dakota using economic measures
- The assessment process has undergone several refinements
 - expanded the geographic scope
 - adjusted the impacts by land use/type

Infestations on Rangeland

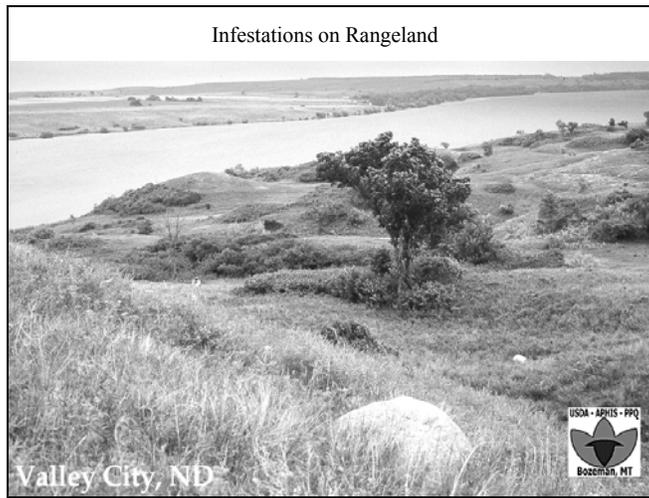


Here are examples of leafy spurge infestations, and how they impact the use of existing land.

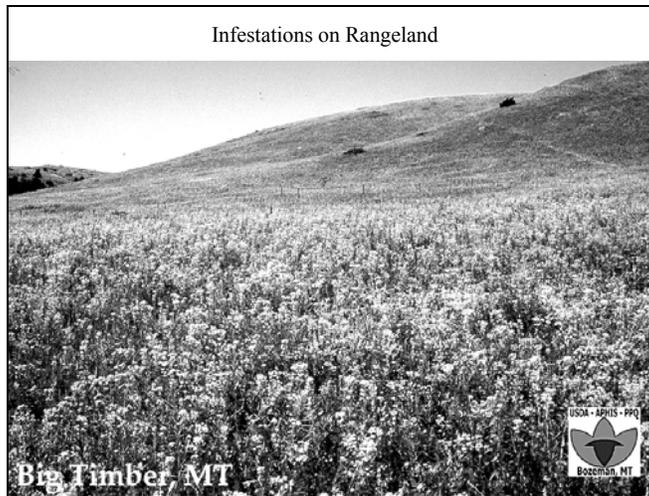
Infestations on Rangeland

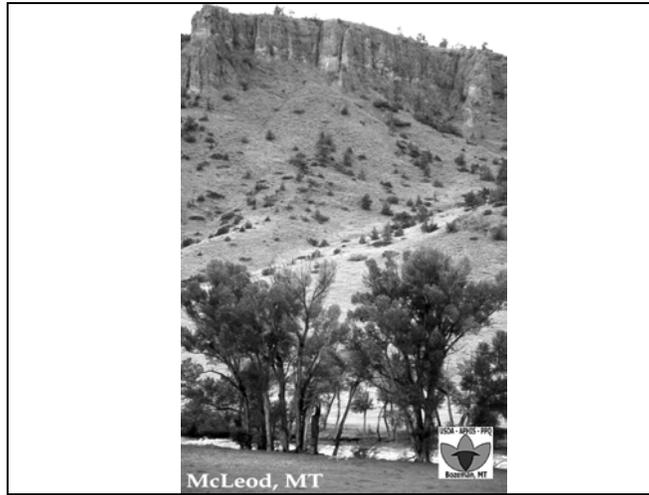


Note the grazing that has occurred outside the infestations and the large areas that are now lost to cattle grazing operations.

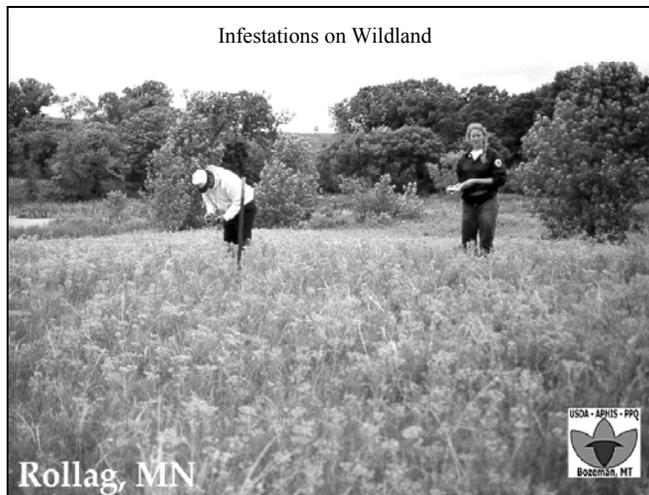


Here is another example of how leafy spurge works its way through the topography of grazing lands to infest the most productive land.



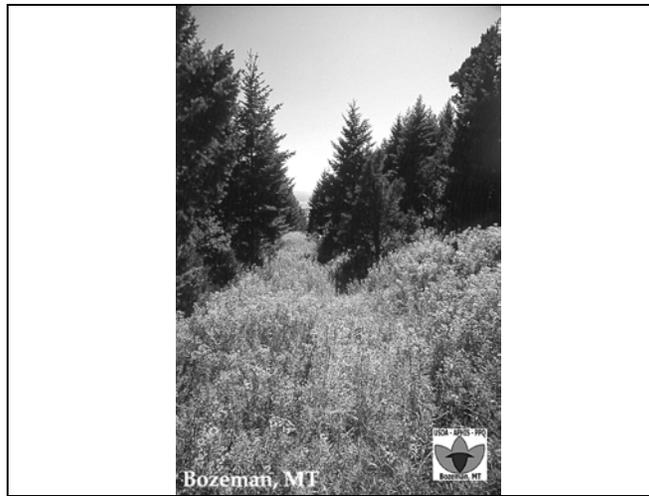
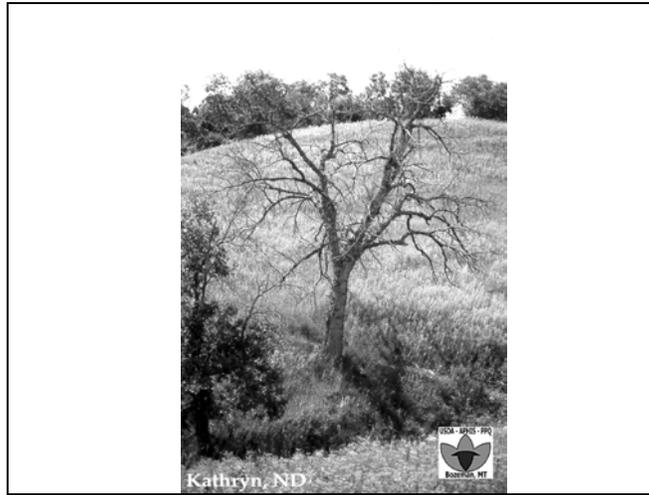


Here is an example of how leafy spurge infests both high moisture areas—very productive land and infests other areas—in this case all the way to the rock face.

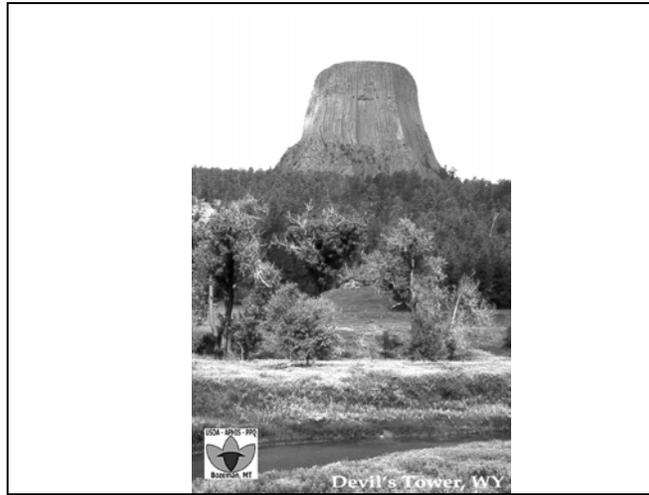


Rangeland isn't the only untillied lands affected by leafy spurge. Here is an example of leafy spurge affecting wildland or in this case wildlife habitat.

We generally classify wildland as non-agricultural untillied lands, primarily used as watershed, wildlife habitat, and/or general outdoor recreational lands.



This photo helps to illustrate the difficulties in treating infestations in rough country and how remote infestations present special problems. In this case, the definition of wildland and rangeland can become blurred. In some cases, the land may not be grazed. In other cases it may. This was more of a problem in the more rugged, mountainous regions of Montana and Wyoming.



Here is an example of public parks that have been invaded by leafy spurge—the problems are prevalent in Theodore Roosevelt National Park, state parks, and other scenic and park resources.

Purpose of Research

- Educate local, state, and national policymakers
- Secure funding for new/emerging leafy spurge research
- Justify continued funding of existing research programs
- Mobilize and prioritize resources at federal, state, and local levels

Critical Components of the Assessment Process--Methods

- Physical relationships between leafy spurge infestations and land outputs
 - Problem (for both rangeland and wildland)
 - Lack of secondary research quantifying the relationships
 - Lack of resources/time to conduct field research
 - Solution
 - Develop postulated relationships (use best estimates/guesses of range/weed scientists)
 - Challenge the physical sciences to refine/improve those relationships

Problems in doing this type of research generally fall into both Methods and Data. When you have both problems, you have to get creative to find acceptable scientific solutions.

Critical Components of the Assessment Process--Data

- Weed Inventories
 - Problem
 - Inconsistent reporting by states & counties
 - Accuracy varied considerably
 - Definition of an infestation varied
 - Insufficient detail on infestation by land type/use
 - Solution
 - Conduct mail and phone surveys to county weed board representatives

There were problems with some counties reporting more leafy spurge than they had untilled lands—which we know is not correct. But state-aid, cost-share programs had formulas based on the amount of leafy spurge: to get more money you had to have more leafy spurge and this caused problems. Also, some counties were greatly underestimating the leafy spurge acreage—which was equally frustrating. However, the two main reporting errors were believed to have neutralizing effects overall.

Some inventories were based on the size of the land tract infested, while others were an attempt to just estimate the actual amount of leafy spurge.

Leafy Spurge Infestations, Upper Midwest, 1993

	Rangeland	Wildland	Total
North Dakota	625,900	350,300	976,200
South Dakota	105,800	68,400	174,200
Montana	351,300	133,900	485,200
Wyoming	60,500	8,900	69,400
Total	1,143,500	561,500	1,705,000

Infestation levels estimated at 1.8 to 2 million acres in 2000

Two thirds of the infestations are on rangeland, and 1/3 are on nonagricultural, untitled lands. Over half of these infestations are located in North Dakota.

The amount of leafy spurge reported in Wyoming has remained much less than the other states, but Wyoming has had a very aggressive and well-funded program to control leafy spurge. While the state is much larger than North Dakota, leafy spurge has found the niche in Wyoming like it has on North Dakota rangelands.

Impact Assessment

- Economic effects of a project, program, activity, or event are categorized into direct and secondary effects
 - Direct effects are changes in economic output, revenue, employment, or income from the initial or first effects (first round impacts)
 - Secondary effects result from subsequent rounds of spending and respending of the direct effects (multiplier effects)
 - Gross business volume (direct and secondary)

When attempting to assess the impact of an event, action, program, or activity, generally the impacts are measured by determining the direct effects, then the secondary effects, and then combining the two types to estimate the total impact.

Rangeland Impacts

- Carrying Capacity Reduction Model (relationship between leafy spurge and lost grazing outputs)
 - 736,200 lost AUMs
- Value of lost AUMs
 - Rental rates and rangeland carrying capacities
 - \$14.50 per AUM (avg. of ND, SD, MT, & WY)
- Cow-calf herd characteristics in each state used to estimate
 - Cow-calf herds that would be supported by lost grazing and expenditures/returns from lost herd
 - 90,000 cow herd

The CCRM was a linear relationship between amount of leafy spurge infestation and land area expressed as a percentage of infestation. The higher the percentage of land infested the greater the loss of grazing outputs. The relationship was developed for beef cattle (cow-calf operations) as about 97 percent of rangeland in the four states is grazed by cattle.

The preferred way to measure grazing output is by animal unit months. This is a figure that represents the amount of forage one animal unit (mature cow) can graze in one month.

Obviously the grazing capacity of rangeland varied extensively in the four-state region. Parts of Wyoming and Montana need 30 or more acres of rangeland per cow for a 6 month grazing period. If you had 100 cows, you would need over 3,000 acres. In some areas of SD, the grazing capacity was near 6 acres per cow per season.

The size of a beef-cow herd is generally limited to the amount of summer pasture land any single producer has. It is impractical to feed beef cows over the long-run with supplemental feed during the summer months (the same reason why drought areas in the US are now seeing herd sell offs because of low grazing capacity).

Direct Economic Impacts- Rangeland-Annual Losses

	Value of Lost AUMs	Cow-herd Expenditures & Returns	Total
-----000s \$-----			
North Dakota	6,876.0	17,317.0	24,193.0
South Dakota	1,803.5	4,572.3	6,375.8
Montana	1,757.7	3,745.2	5,502.9
Wyoming	216.6	816.5	1,033.1
Total	10,653.8	26,451.0	37,104.8

Note that SD had about 1/3 of the estimated acreage of leafy spurge that Montana had, but the economic loss was higher—this is due to the productive differences in rangeland in the two states.

Wildland Impacts

- Leafy spurge infestations reduce plant diversity and reduce native vegetation
- Most outputs from wildlands are not market based (non-market goods)
- Challenge: how to measure the physical and economic effects of leafy spurge infestations on non-market goods

The primary physical effect of leafy spurge on wildland is a reduction in native vegetation.

Wildland Impacts

- Market goods--timber, minerals--not affected by leafy spurge (wildland grazed was included as rangeland)
- Non-market goods affected by leafy spurge
 - Reduced soil and water conservation benefits
 - Increased erosion
 - Increased water runoff
 - increased water treatment costs, sediment removal costs, increased flood damage, and reduced recreational fishing
 - Reduced wildlife habitat quality, which leads to reduced wildlife populations, which reduces wildlife-based recreation
 - Aesthetics and intangibles

Most larger game animals will not eat leafy spurge, and have similar avoidance to the plant as cattle/horses—their physiology, grazing preferences are similar.

The question remains: do dense leafy spurge infestations on rangeland provide more habitat value and less erosion than over grazing pasture—no evidence to suggest either way.

Wildland Impacts

- Several *postulated* relationships were developed to link reductions in non-market goods to market-based economic impacts
 - Link between CRP and soil erosion
 - Role of wildland in producing wildlife (species land use coefficients)
 - Relationship between leafy spurge and wildlife habitat productivity
 - Wildlife-related expenditures (state level)
 - Developed formulas/procedures to combine above factors

CRP was designed to take erodible land out of production and place into permanent cover (grasses and legumes). The value of reduced soil erosion from these lands was used in the development of estimates for increased soil and water erosion from leafy spurge infestations.

Not all wildlife is produced on wildland; however, the amount produced on wildland is a function of the type of wildland in a given area, and percentage of all land in an area that is wildland. Small amounts of leafy spurge were predicted to have minimal effects on wildlife habitat, but as the percentage of land infested increases, the effects become more pronounced. Species land use coefficient applies to the mix of wildlife in any particular area. Wildlife related expenditures were obtained from US Fish and Wildlife.

Direct Economic Impacts-Wildland- Annual Losses

	Reductions in		Total
	Soil & Water Conservation Benefits	Wildlife- Recreation Expenditures	
-----000s \$-----			
North Dakota	514.1	2,111.6	2,625.7
South Dakota	102.9	163.8	266.8
Montana	328.1	137.4	465.5
Wyoming	21.8	19.0	40.8
Total	966.9	2,431.8	3,398.8

72 percent of the direct economic impacts result from habitat losses, and subsequent reductions in outdoor recreation expenditures. Soil and water conservation benefits are relatively minor.

Direct, Secondary, and Total Annual Impacts-Rangeland

	Direct	Secondary	Total
	----- 000s \$ -----		
North Dakota	24,193.0	53,989	78,182
South Dakota	6,375.8	14,230	20,606
Montana	5,502.9	12,091	17,594
Wyoming	1,033.1	2,269	3,302
Total	37,104.8	82,579	119,684

These impacts average \$105 per acre of leafy spurge on rangeland.

The secondary economic impacts were estimated using the ND Input-Output model. Input-output analysis is the technique economists use to estimate the dollar flows in an economy, or the linkages between spending in one economic sector and spending in other economic sectors. The linkages, or interdependence coefficients in the model, translate into what you call the multiplier effects.

Much of the impact of leafy spurge starts with losses from the landowner, in the case of rangeland, and then becomes an economic loss or burden to other sectors of the economy that are linked to the spending that would have occurred if those lands were not infested.

Direct, Secondary, and Total Annual Impacts-Wildland

	Direct	Secondary	Total
	----- 000s \$ -----		
North Dakota	2,625.7	5,291	7,917
South Dakota	266.8	461	728
Montana	465.5	576	1,041
Wyoming	40.8	63	104
Total	3,398.8	6,391	9,790

These impacts average \$17 per acre on wildland. Over 80% of the wildland impacts occur in North Dakota.

Rangeland and Wildland Impacts

	Direct	Secondary	Total
	----- 000s \$ -----		
North Dakota	26,819	59,280	86,099
South Dakota	6,643	14,691	21,334
Montana	5,968	12,667	18,635
Wyoming	1,074	2,332	3,406
Total	40,504	88,970	129,474

These impacts average, between rangeland and wildland, to about \$76 per acre of leafy spurge. The impact of leafy spurge or the economic burden of the weed in North Dakota alone was about \$86 million in the mid 1990s.

The value of generating these estimates lies not with their precision (the math is correct), but these are estimates based on the best data and methods available at the time. However, we can not state with certainty that the impact is precisely 129,474, but we can state with certainty the impact is substantial. Even if these figures are off by 50%, which I doubt, but let's say they are for the sake of argument, roughly \$65 million is still a lot of economic drain from one weed in four states.

Conclusions

- In addition to *ecological* concerns, leafy spurge is a serious *economic* problem
 - Private sector effects
 - Landowners (lost grazing, reduced cow herds, property values)
 - Agricultural businesses (supply, finance, livestock services)
 - Non-agricultural sectors of the economy
 - Public sector effects
 - lost tax revenues
 - public cost/burden of combating the weed

Conclusions

- Accepted approach to assessing economic impacts of weeds
 - Refereed and non-refereed publications
 - Bio-economic model is not without shortcomings; however, few refinements or improvements have been suggested
 - The bio-economic model is adaptable to other weeds
 - Knapweed (1996 study showed \$40 million impact in MT)
 - Plans to adapt methods to purple loosestrife & phragmites

The Manitoba Leafy Spurge Stakeholders Group conducted a study, adapting our methods to the assessment of the economic effects of leafy spurge in Manitoba in 1999/2000. Their first study estimated the problem at nearly \$20 million.

Conclusions

- Value of economic impact studies of noxious weeds
 - Education and awareness
 - Local and state governments
 - National interests (APHIS, ARS, others)
 - Retain and secure funding for research for leafy spurge and other noxious weeds
 - Economic value of control programs--economy wide benefits from biological control
 - 1997 Study demonstrating potential returns from investment in biological control programs