

Economic Impact of Leafy Spurge on North Dakota Wildland

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Leafy spurge is a non-native species that has spread at alarming rates on untilled land since it was first sighted in North Dakota in 1909 (Lym and Messersmith, 1985). The acreage of leafy spurge has doubled every 10 years for the last 30 years and is likely to double again in 10 years (Stroh et al., 1990). Found in every county in North Dakota, leafy spurge displaces existing and native vegetation (Watson, 1985) and is difficult to control with current technology (herbicides).

After establishment, leafy spurge tends to displace other vegetation and establish single species stands, reducing production of desirable forages. Leafy spurge expansion has been exacerbated by difficulty in control. No single treatment will eradicate leafy spurge and effective control must be considered a long-term management program (Lym et al., 1988).

The continued expansion of leafy spurge and its ability to withstand eradication has resulted in substantial direct economic losses for the agricultural sector in North Dakota, South Dakota, Montana, and Wyoming due to infestations on pasture and rangeland (Thompson et al., 1990 and Bangsund and Leistritz, 1991). In North Dakota, rancher incomes and production outlays associated with ranchers' herds were reduced by \$23.1 million and total business activity was reduced by \$76.3 million in 1990 (Bangsund and Leistritz, 1991).

Pasture and rangeland are not the only types of land leafy spurge affects

(Wallace, 1992). Leafy spurge also infests other non-tilled land, such as road ditches, recreation areas, and wildlife production areas. The outputs of other non-tilled land (wildland) provide direct and indirect social and economic benefits to society. Leafy spurge infestation can cause similarly adverse economic impacts on wildland as on pasture and rangeland.

Objectives

The overall objective of this study was to develop a procedure to estimate, and to make an initial estimate of the economic impact of leafy spurge on North Dakota wildland. Specific tasks included:

1. Estimating acres of wildland and acres of wildland infested with leafy spurge in North Dakota,
2. Identifying and quantifying the outputs/benefits of North Dakota wildland,
3. Estimating the physical impacts of leafy spurge on the outputs of North Dakota wildland,
4. Estimating the economic impact of leafy spurge infested wildland on the regional (North Dakota) economy, and
5. Identifying the gaps in natural and physical science research that describe the physical relationships between leafy spurge and wildland outputs.

Procedures

Wildland acreage was estimated using existing data. Acres of wildland infested with leafy spurge were estimated using data obtained from a survey of representatives of the county weed boards. Wildland benefits and the biophysical impacts of leafy spurge on wildland benefits were identified and estimated using information from published literature and input from wildlife and soil science specialists.

Wildlife-associated recreation and soil and water conservation were identified as wildland benefits. These benefit categories serve as a conservative proxy for all wildland benefits. Wildland benefit values were based on wildlife-associated recreation expenditures and water users' treatment costs. The North Dakota 18-sector Input-Output Model (Coon et al., 1990) was used to estimate regional economic impacts (direct and secondary impacts). Gaps in physical and natural science literature were identified as work progressed on the first four objectives.

Wildland

Wildland can be broadly defined as land not used for industrial, urban, or agricultural purposes and includes forests, recreation areas, and wilderness (Randall and Peterson, 1984). Wildland acreage was estimated at 4,899,000 acres, approximately 10 percent of total North Dakota acreage. Approximately 10 percent, or 468,000 acres of wildland were infested with leafy spurge (Wallace, 1992).

Wildland is both publicly and privately owned and provides a variety of goods and services, such as forest products and mineral resources, as well as non-market goods such as recreation, wildlife habitat, erosion control, and watershed benefits (Randall and Peterson, 1984).

Biophysical Impacts

Leafy spurge literally chokes out other existing vegetation and is clearly related to a decline in native and existing wildland vegetation (Belcher and Wilson, 1989). A substantial change in plant

diversity due to leafy spurge may not provide the necessary cover or forage to support existing wildlife populations. Assuming a change in plant biodiversity would affect wildlife carrying capacity, an impact function was estimated to describe the relationship between leafy spurge infestation and wildland habitat value (Figure 1).

As leafy spurge displaces native and existing vegetation, it changes the character and composition of wildland vegetative cover, an important factor influencing runoff and soil erosion. A change in vegetative cover due to leafy spurge may affect soil erosion and runoff, thereby altering wildland soil and water conservation benefits. Examples of off-site soil erosion damage are increased flood damage, damage to aquatic ecosystems, reduced water-based recreation opportunities, increased municipal and industrial water treatment costs, accelerated loss of water storage capacity, and aggradation and siltation of navigation and water conveyance channels (U.S.

Environmental Protection Agency, 1984; Ribaud, 1986 and 1989).

Removal of highly erodible cropland from production and placement into trees or grassland through the Conservation Reserve Program (CRP) has led to increased off-site water quality (Ribaud 1989). The diverse vegetative cover of CRP land increases off-site soil and water conservation benefits by reducing runoff and soil erosion. A converse situation is possible with leafy spurge on wildland. As the vegetative cover changes from more diverse to less diverse, moving to a leafy spurge monoculture, run-off and soil erosion may increase, resulting in reduced off-site water quality.

A definitive estimate of increased runoff and soil erosion due to leafy spurge is not available at this time due to the lack of physical science research describing the relationship between runoff, soil erosion, and leafy spurge. However, assuming, 1) wildland without leafy spurge provides on- and off-site soil and water conservation benefits analogous to

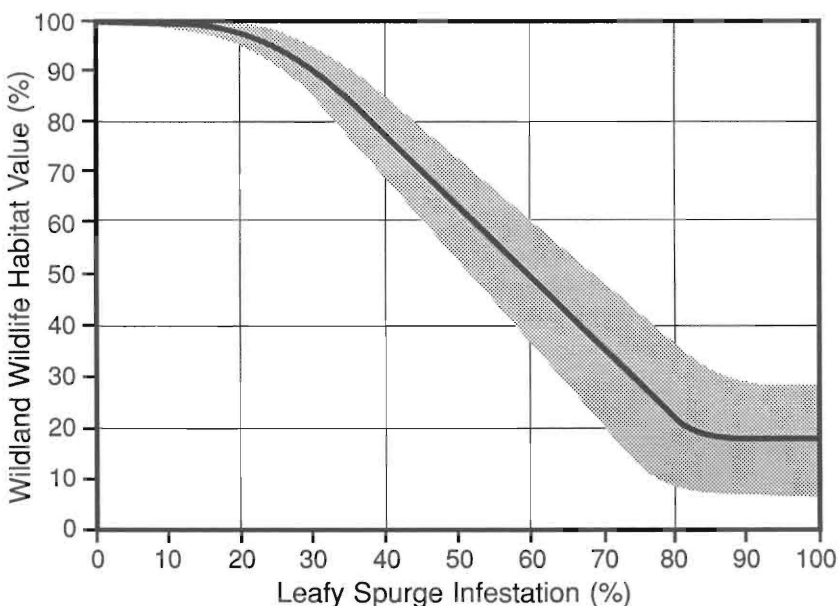


Figure 1. Estimates of reduced wildland wildlife habitat value caused by various leafy spurge infestation rates. (Shading along the function indicates there is uncertainty associated with the assumed relationship.)

CRP acres and, 2) wildland with leafy spurge provides fewer on- and off-site soil and water conservation benefits than wildland without leafy spurge, a percentage reduction can be a postulate for possible reductions in on- and off-site soil and water-conservation benefits due to a leafy spurge infestation. For this study, it is assumed a 100 percent infestation reduces wildland off-site water conservation benefits by one-fourth (Figure 2).

Direct Economic Impacts

Economic impacts are increases or decreases in economic activity due to the expansion or shrinkage of a particular firm, industry, or sector in the area economy (Coon et al., 1985). Direct economic impacts from changes in wildlife-associated recreation are the changes in wildlife-associated recreationist expenditures. Through the purchase of special equipment, gasoline, food, lodging, and other services, the state's economy is impacted by the economic activity generated by individuals pursuing wildlife-associated recreation.

The reduction in wildlife-associated recreation expenditures from the 468,000-acre wildland leafy spurge infestation is estimated by multiplying the percentage reduction in wildland habitat value and the percentage of wildland that is leafy spurge infested by the percentage of wildlife-associated recreation expenditures attributable to wildlands. Forty-two percent of those expenditures are estimated to be lost to the state's economy due to recreationists pursuing wildlife-associated recreation opportunities out of state (Wallace, 1992). The reduction in wildlife-associated recreation expenditures can be represented by the following function:

$$R = (E \times C)(H \times W)(S)$$

- where
- R = Change in wildlife-associated recreation expenditures due to leafy spurge infestation on wildland
 - E = Total wildlife-associated recreation expenditures
 - C = Species/land use coefficient
 - H = Percentage reduction in wildlife habitat value
 - W = Percentage of leafy spurge-infested wildland
 - S = Percentage of expenditures lost to state economy
- $$R = (\$219,702,000 \times .40)(.80 \times .10)(.42)$$
- $$R = \$2,952,795$$

The reduction in wildlife-associated recreation expenditures due to the current leafy spurge infestation on wildland is estimated to be \$2.9 million.

Direct economic impacts of soil and water conservation are defined in terms of changes in water user's defensive expenditures to prevent or counteract damage from pollutants from soil erosion and runoff. To illustrate, water for municipal and industrial use is generally treated before use. The changes in treatment costs represent the benefits (costs) of increased (decreased) water quality. Increased (decreased) water quality represents direct economic impacts (either benefits or costs) to water users.

The economic impacts of leafy spurge on wildland soil and water conservation were estimated by applying the assumed 25 percent reduction in wild-land water conservation benefits due to the leafy spurge infestation to the per acre benefits of placing highly erodible cropland into the Conservation Reserve Program (wildlands without leafy spurge assumed analogous to CRP). The resultant per acre reduction in benefits is multiplied by the acres of leafy spurge infested wildland to estimate the value of reduced soil and water conservation benefits. The reduction in wildland soil and water conservation benefits due to the current leafy spurge infestation is estimated to be \$0.7 million.

Secondary Economic Impacts

Secondary or regional economic impacts are the resultant changes in business activity in other economic sectors of the North Dakota economy due to an initial change in business activity in one or more sectors. The North Dakota 18-Sector Input-Output Model traces the linkages among the business sectors and calculates additions or reductions in total business activity and business activity in other sectors (secondary economic impacts), as well as estimating the number of jobs gained or lost. Total (North Dakota) economic impact of reduced wildlife-associated recreation and reduced soil and water conservation due to the

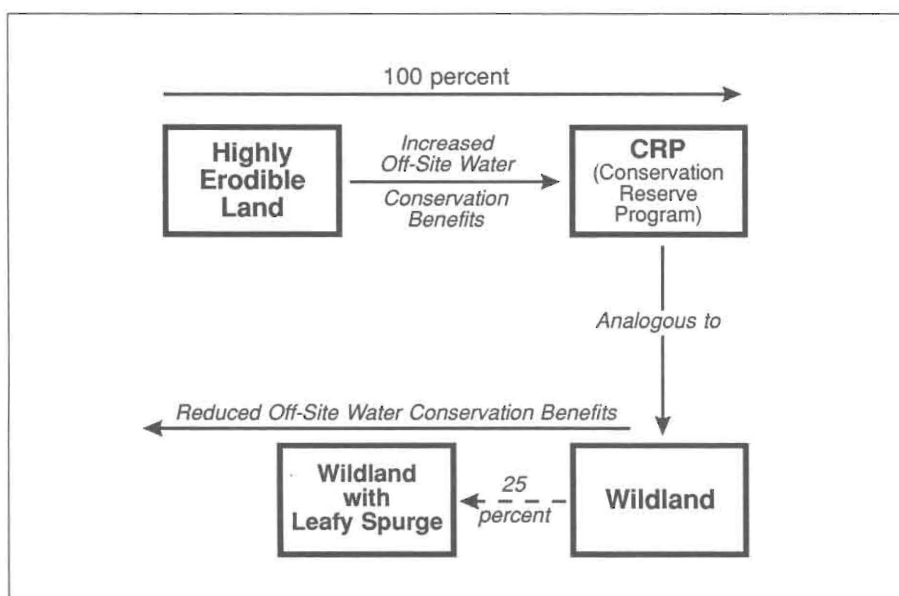


Figure 2. Conceptual relationship of highly erodible land, Conservation Reserve Program (CRP), and Wildland.

current leafy spurge infestation is the sum of direct and secondary economic impacts.

Tourism and Recreation, Government, Agriculture—Crops, and Electricity Generation are the business sectors impacted by reduced wildlife-associated recreation and soil and water conservation. Reductions in business sector activity (direct impacts) were \$2.9 million, \$0.5 million, \$0.2 million, and \$7,000, respectively. The \$3.6 million in direct economic impacts reduced total business activity (direct and secondary impacts) by \$11.0 million, enough to support 187 jobs. The Recreation and Tourism sector had an over \$2.9 million reduction in gross business volume (gross receipts). Reductions in personal income were estimated at over \$2.1 million.

Conclusions

This study is a first attempt to estimate regional economic impacts of leafy spurge on wildland in North Dakota. The present leafy spurge infestation on North Dakota wildland has direct economic impacts of over \$3.6 million. Total forgone business activity (direct plus secondary impacts) is estimated to be \$11.0 million, enough to support 187 jobs.

Further research is needed to refine the impact assessment. Specific data needs include:

- expansion of the annual estimation of leafy spurge infestation per county to include the land use/cover on which the infestation occurs (e.g., rangeland or road ditches), and
- identification of ownership of spurge-infested land (e.g., public or private, federal or state).

Biophysical research needs include:

- a more precise description of the physical relationship between leafy spurge, wildland, and wildlife populations, and
- physical research to describe the impact of leafy spurge on run-off and soil erosion.

This information would help to more confidently assess the impacts of leafy spurge on different types of land as well as identify who is impacted by leafy spurge infestations and to what extent.

The results of this first estimate of the economic impacts of leafy spurge on wildland are, of course, sensitive to the many assumptions made in the study. Reliable methods are available to refine the estimate of economic impacts of leafy spurge on wildland, provided the physical relationship between leafy spurge and wildland outputs can be modeled. As the biophysical relationships of leafy spurge and wildland are refined, the improved data can be applied to the framework for estimating economic impacts developed in this study.

Without feasible control, the continued expansion of leafy spurge is certain, as are continued reductions in personal income and business activity. Direct economic impacts of leafy spurge on range and pastureland (reduced personal income and lost cash outlays) were estimated at \$23.1 million. Total impacts (direct plus secondary impacts) due to leafy spurge on range and pastureland in North Dakota were estimated at \$76.3 million. Combining the economic impacts of leafy spurge on rangeland (\$76.3 million) with the economic impacts of leafy spurge on wildland (\$11.0 million) provides the best estimate for total (direct plus secondary) economic impacts due to the current leafy spurge infestation (Figure 3). Total annual economic

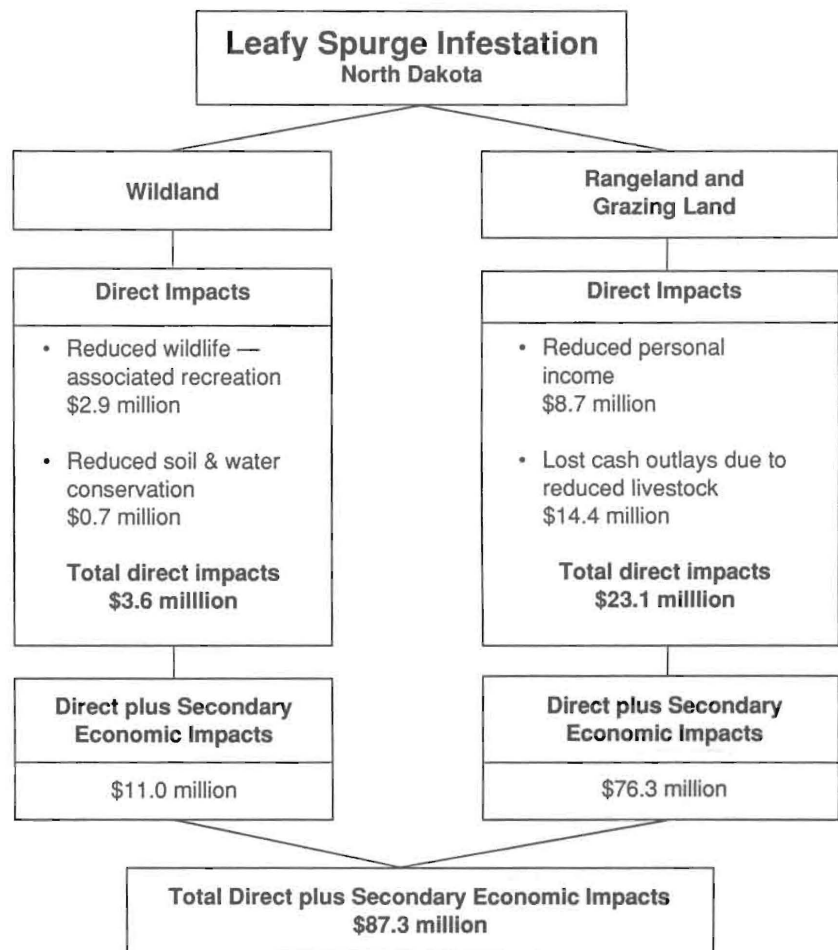


Figure 3. Bioeconomic impact assessment of leafy spurge in North Dakota.

impacts (direct plus secondary) in North Dakota are estimated at \$87.3 million.

Due to the many assumptions made in estimating the economic impacts of leafy spurge on wildland and rangeland, a margin of error exists. The confidence interval surrounding the \$87.3 million estimate, however, is not the most important implication of this research. These approximations suggest that leafy spurge is a major problem in North Dakota. The substantial losses associated with the leafy spurge infestation reinforce the need for continued research aimed at developing efficient, economical control methods. Considering the historic and potential, future expansion of leafy spurge, further economic losses associated with continued expansion are likely and will intensify the need for cost effective control methods. However, until a feasible solution is found, even with the high level of losses associated with the current leafy spurge infestation, it is important that the cost of control (using current control methods) does not exceed the benefit of control.

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