

Browsing of Western Snowberry by Goats and Sheep¹

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Summary

Managers of pastures in the northern tallgrass prairie region are faced with incomplete control of aggressive woody plant species, such as western snowberry (*Symphoricarpus occidentalis* Hook.), due to its high sprouting ability after fire or mowing and the reluctance of managers to use herbicides, which may harm desirable plant species. The objective of this study was to compare browsing preference for western snowberry by goats and sheep as an alternative control method of western snowberry. The study was conducted from 2003 through 2005 at South Dakota State University's Oak Lake Field Station in eastern South Dakota. Small, fenced plots of native prairie vegetation, infested with western snowberry, were grazed by either sheep or goats for three to five days in late June.

Western snowberry plant height, foliar cover, forb foliar cover, and grass foliar cover were measured before and after grazing. During the grazing period, goats reduced western snowberry more than did sheep, reducing plant height 12 percent vs. 0 percent and foliar cover 43 percent vs. 19 percent, respectively ($P < 0.10$) adjusted for similar stocking rate. Goats also selected forbs, reducing forb foliar cover by 44 percent vs. 28 percent ($P < 0.10$) for sheep during the grazing period. Goats and sheep selected grass to a similar extent. Goats could be an acceptable alternative to herbicides for western snowberry control. However, managers also should be aware that heavy defoliation of forbs by both species may result in a decrease in desirable plant species.

Key words: Browse, Goats, Sheep, Weeds, Woody Plants

Introduction

The role of grazing animals in providing biological control of unwanted vegetation has been shown to be favored over the use of herbicides, biological control by insects or pathogens, and prescribed burning (Wagner et al., 1998). Costs of herbicides and concerns over environmental safety have made biological control of some unwanted woody species by grazing an attractive alternative (Magaddele et al., 1995). Goat grazing has been an effective, low-cost alternative to herbicides for controlling multiflora rose (*Rosa multiflora* Thumb.) in hill land pasture of the Appalachian region (Luginbuhl et al. 1999) and in reducing brush regrowth in fuelbreaks in California chaparral (Green and Newell 1982). In Kansas, goats have been successful in reducing stem density and biomass of sericea lespedeza [*Lepedeza cuneata* (Dum.-Cours.) Don], an aggressive herbaceous to near-woody perennial plant that invades disturbed sites (Mayo, 2002). Goat and sheep grazing has received attention in the popular press from innovative people and organizations using them to control unwanted vegetation under powerlines (Murray, 2001), in parks and city boulevards (Pfankuch, 2001), and to reduce fuel to prevent forest fires (Revkin, 2000).

Pastureland and native prairie in the eastern Great Plains can be invaded by western snowberry (*Symphoricarpos occidentalis* Hook.), a perennial woody shrub with an expansive root system that forms dense colonies up to 200 m in diameter (Pelton, 1953). Western snowberry is widely distributed from Ontario to British Columbia in Canada and south to northern Missouri, west through Oklahoma, New Mexico, Utah, and Washington in the United States (Johnson and Larson, 1999). High-density western snowberry infestations can severely limit grass understory growth by reducing nitrogen availability (Wilson, 2000). Reports of local, high-density infestations, as a result of cattle not being effective in controlling western snowberry, give rise to suggested alternative control strategies, such as the use of herbicides, mowing, or browsers (Bailey et al., 1990). Observations from the Oak Lake Field Station in eastern South Dakota have shown that western snowberry readily resprouts after mowing or

prescribed burning (A.J. Smart, unpublished data). Research is lacking on the diet selection of goats or sheep grazing native vegetation to control western snowberry in the tallgrass prairie. Goats and sheep could offer a promising alternative control method of unwanted woody vegetation. The objective of this study was to compare browsing of western snowberry by goats and sheep.

Materials and Methods

Study site

The study was conducted from 2003 through 2005 at the South Dakota State University Oak Lake Field Station, approximately 5.5 km south of Astoria, South Dakota, in the northern tallgrass prairie. Climate is continental with cold dry winters and wet hot summers. Average annual precipitation is 582 mm (1995-2004) (USDC, 2004). Soils are of the Buse-Laghei complex (Fine-loamy, mixed udic calciborolls). Dominant vegetation is composed of cool-season grasses, such as Kentucky bluegrass (*Poa pratensis* L.), smooth bromegrass (*Bromus inermis* Leyss.), and green needlegrass [*Nassella viridula* (Trin.) Barkworth]; warm-season grasses, such as big bluestem (*Andropogon gerardii* Vitman), sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.], and prairie dropseed (*Sporobolus heterolepis* A. Gray); and forbs, such as goldenrod (*Solidago* spp.) species, wild bergamot (*Monarda fistulosa* L.), aster species (*Aster* spp.), and thistle species (*Cirsium* spp.).

Experimental design

Eight experimental pastures ranging from 63 m² to 134 m² were randomly located within the study site infested with western snowberry. The variability in pasture size was dictated by the heterogeneity of the western snowberry

infestation. Fifteen mature Spanish female goats weighing approximately 45 kg each were randomly assigned to five 89-m² pastures, 3 goats in each pasture. Eight mature female Finn-Dorset-Targhee sheep weighing approximately 70 kg each were assigned to three pastures, two sheep in the two 63-m² pastures and four sheep in the 134-m² pasture. Grazing was conducted for three to five days in late-June of 2003, 2004 and 2005. Attempts were made to use the same stocking rate in the goat and sheep pastures. However, they ranged from 4.5 to 6.2 animal unit months (AUM) ha⁻¹ (Table 1). One AUM equals the amount of oven-dry forage required by one animal unit (454 kg) for a standardized period of 30 days (Bedell, 1998). Stocking rates used in this study were typical of those suggested for eastern South Dakota (Albee et al., 1948). The experimental design was a completely randomized design with pasture considered the experimental unit, five replicates for goats, and three replicates for sheep.

Vegetation measurements

Foliar cover of western snowberry, grass, and forbs was visually estimated in 0.25 m² quadrats from four to five quadrats approximately 1 m apart along three to five 9-m long transects for a total of 15 to 20 samples in each pasture before and immediately following the grazing period. Western snowberry plant height measured from the soil surface to the last extended leaf was estimated from 75 to 100 samples by randomly choosing five plants within each 0.25 m² quadrat before and immediately following the grazing period. Percent change in foliar cover of western snowberry, grasses, forbs and western snowberry plant height for each year was calculated as pregrazing value minus postgrazing value divided by pregrazing value times 100.

Table 1. Stocking rates of goats and sheep grazing in western snowberry infested pastures in eastern South Dakota from 2003 to 2005.

Year	Animal Species	
	Goats	Sheep
2003	5.6	6.2
2004	4.5	6.2
2005	4.6	4.5

Statistical analysis

Due to the variability in stocking rate among species and years, response variables were divided by the stocking rate to standardize the data and remove the confounding effect of stocking rate. Percent change in foliar cover and western snowberry plant height divided by stocking rate was analyzed by year and animal species as a two-way analysis of variance with year considered a repeated measure. The analyses were computed using PROC MIXED (SAS, 1999) with a compound symmetry model that adequately accounted for error correlation during the three years. Least squares means were separated using the PDIF option (SAS, 1999) and considered statistically significant at the 0.10 probability level.

Results and Discussion

Changes in foliar cover and plant height reduction of western snowberry differed between goats and sheep. Goats readily and consistently browsed western snowberry leaves each of three years (Table 2), reducing foliar cover of western snowberry by 43 percent ($P < 0.10$) compared with 19 percent reduction by sheep compared at the same stocking rate. Goats also browsed twigs of western snowberry, which reduced western snowberry plant height each year compared to sheep (Table 3). Averaged over the three years, goats reduced plant height by approximately 12 percent compared to 0 percent for sheep ($P < 0.10$) adjusted for common stocking rate. The negative number in Table 3 indicates plant height increased following grazing. Sheep grazing did not offset plant height since they apparently ate leaves rather than browsed stem. Based on diet selectivity of sheep, this was not surprising.

Percent change in foliar cover of grass adjusted for stocking rate varied by year and animal species (Table 4) and as indicated by a significant year x species interaction ($P = 0.09$). Yearly differences may have been a result of different animals used in the study and their preference for grass during the experimental period. However, when averaged over the three years, goat and sheep preference for grass was similar ($P = 0.62$). Diet preference for forbs, as indicated by decrease in forb foliar cover averaged

Table 2. Percent change in western snowberry cover divided by stocking rate after goat and sheep grazing in western snowberry infested pastures in eastern South Dakota from 2003 to 2005.

Year	Animal Species	
	Goats	Sheep
	----- % Change/AUM/ha -----	
2003	35 ^b	15 ^d
2004	45 ^a	27 ^c
2005	47 ^a	16 ^d
Average	43 ^y	19 ^z

^{a,b,c,d} Means within a row or column followed by a similar letter are not significantly different ($P > 0.10$).

^{y,z} Means within a row followed by a similar letter are not significantly different ($P > 0.10$).

Table 3. Percent change in western snowberry plant height divided by stocking rate after goat and sheep grazing in western snowberry infested pastures in eastern South Dakota from 2003 to 2005.

Year	Animal Species	
	Goats	Sheep
	----- % Change/AUM/ha -----	
2003	13 ^a	0 ^b
2004	11 ^a	2 ^b
2005	12 ^a	-3 ^b
Average	12 ^y	0 ^z

^{a,b} Means within a row or column followed by a similar letter are not significantly different ($P > 0.10$).

^{y,z} Means within a row followed by a similar letter are not significantly different ($P > 0.10$).

Table 4. Percent change in grass cover divided by stocking rate after goat and sheep grazing in western snowberry infested pastures in eastern South Dakota from 2003 to 2005.

Year	Animal Species	
	Goats	Sheep
	----- % Change/AUM/ha -----	
2003	31 ^a	27 ^{ab}
2004	20 ^b	32 ^a
2005	9 ^c	6 ^c
Average	20 ^z	22 ^z

^{a,b} Means within a row or column followed by a similar letter are not significantly different ($P > 0.10$).

^z Means within a row followed by a similar letter are not significantly different ($P > 0.10$).

over the three years, was higher ($P < 0.01$) for goats than sheep, as expected (Table 5).

Diet preferences of goats tend to be skewed toward woody and broadleaf

plants compared to sheep which have wider diet selection tendencies (Bartolome et al., 1998; Squires, 1982). Our data supports this observation. Body size, prehensile ability, and agility are directly

Table 5. Percent change in forb cover divided by stocking rate after goat and sheep grazing in western snowberry infested pastures in eastern South Dakota from 2003 to 2005.

Year	Animal Species	
	Goats	Sheep
	----- % Change/AUM/ha -----	
2003	41 ^a	30 ^b
2004	44 ^a	28 ^b
2005	48 ^a	26 ^b
Average	44 ^y	28 ^z

^{a,b} Means within a row or column followed by a similar letter are not significantly different ($P > 0.10$).

^{y,z} Means within a row followed by a similar letter are not significantly different ($P > 0.10$).

related to the animal's ability to browse on woody vegetation (Bartolome et al., 1998; Hofmann, 1988; Milne, 1991). These differences make selective grazers, such as goats and sheep, useful biological controls for woody vegetation. However, other factors, such as contrasting dry and wet seasons, can also influence the feeding behavior of goats and sheep (Kronberg and Malechek, 1997). Sheep shifted their foraging behavior toward more browse when high-quantity, low-quality forage was available during the dry-season in Brazil (Kronberg and Malechek, 1997). Bailey et al. (1990) observed that western snowberry was more acceptable to cattle later in the growing season compared with grazing

early in the growing season. This might be related to the availability of green grass throughout the growing season. It is reasonable to assume that sheep may also select western snowberry to a greater degree later in the grazing season, especially in late-summer when cool-season grasses would be going dormant and declining in quality.

Goats and sheep will graze forb species and have been shown to be a useful tool to reduce undesirable or invasive forb species, such as thistles or leafy spurge (*Euphorbia esula* L.) (Walker et al., 1994). Goats and sheep may differ in their degree of use of forbs depending on the species present (Bartolome et al., 1998; Walker et al., 1994). We observed

goats to reduce foliar cover of forbs present in this study to a greater degree than sheep. Bartolome et al. (1998) showed similar amounts of forb fragments in feces of sheep and goats, which indicated that they did not differ in their preference for forbs. Therefore, managers should be aware that sheep and goats may graze desirable forb species, so a planned grazing system should be used to allow desirable plants adequate time to recover from defoliation.

Conclusion

When sheep and goat grazing responses were expressed as a function of stocking rate, goat grazing resulted in a greater reduction in western snowberry foliar cover compared to sheep grazing. Because goats removed both stem and leaf material compared to sheep that grazed only leaves, plant height was reduced more under goat compared to sheep grazing when expressed at the same stocking rate. Also, goats preferred forbs by reducing forb foliar cover more than sheep. Both animal species selected grass to a similar extent. Our data indicate that goats are more effective at controlling western snowberry than sheep. Managers that elect not to use herbicides, due to higher risks of damaging non-targeted plant species, must be aware that goats or sheep may also heavily graze desirable forbs.

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