United States Department of Agriculture
Natural Resources Conservation Service

Minnesota Practice 528
Biological Brush Management
Implementation Guide

Natural Resources Conservation Service (NRCS)
Minnesota

Practice Code 528
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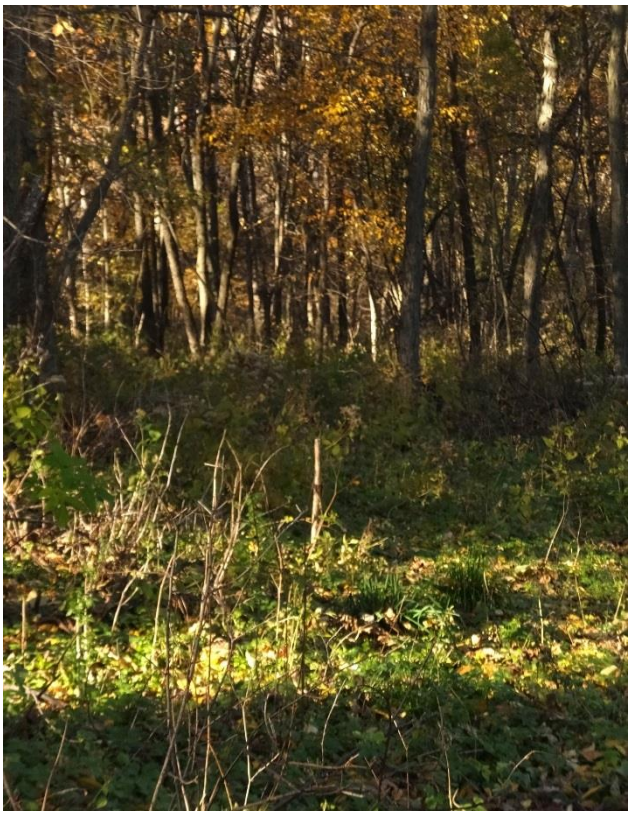


Woodland understory more than 40% buckthorn. Photo taken in Rice County, MN. Kopp 2014

Woodland understory after goat grazing. Photo taken in Rice County, MN. Kopp 2014

Definition

Biological Brush Management is the reduction or removal of woody plants including those that are invasive and noxious, accomplished primarily by ruminant species browsing, trampling and stripping bark. For Biological removal of herbaceous plants see Herbaceous Weed Management.

Purposes

The practice is used to provide forage for livestock and manage unacceptable levels of brushy species (trees, shrubs and woody vines) in woodlands, forests, pastures, and rangeland to promote desirable plant growth. The practice may facilitate management of forests, pastures and rangeland, and improve wildlife habitat and can be used to manage unacceptable concentrations of invasive species such as buckthorn, honeysuckle or other plants listed in the Minnesota DNR invasive plants list.

Conditions Where Practice Applies

On forests, native and naturalized pastures, rangeland, wildlife lands, and other lands where trees and shrubs need to be removed to restore or create the desired plant community. Grazing and browsing animals will be used to defoliate the undesired trees and shrubs.

Criteria for Brush Management

Estimating Brush Canopy

Brush canopy estimates will be obtained by counting the number of brush clumps and their percent of area in plots. If the tree or shrub cover is uniform, a 66- by 66-foot plot of 0.1 acre is suitable. If vegetation is unevenly spaced, a more accurate sample can be obtained by using a 0.1-acre plot, 4.356 feet wide and 1,000 feet long. The NRCS National Range and Pasture Handbook, Chapter 4, provides details about monitoring brush composition, yield, and canopy. Identify target species for control and management and estimate concentration and location.

Beginning threshold:

The canopy of brush species will exceed 25% measured at or below seven feet, averaged throughout the targeted area. Brushy species with leaves above seven feet, and with stiff stems that goats cannot bend down to the ground, will not be accessible to livestock and require lopping or chain sawing to force the brush to leaf out within reach of the goats.

Minimum Defoliation:

For Control and Brush Eradication: all brush species will have at least 80% leaf removal and some twigs possibly eaten below seven feet in height throughout the treatment area by mid- August. For Sustainable Browse Management, limit defoliation to no more than 50% leaf removal.

Method/Implementation

Where there is less than 10% brush cover and the goal is invasive species control, use the herbaceous weed control standard and associated Jobsheet.

A Forage Balance Sheet will be developed to estimate the available feed and livestock intake.

Goats have variable daily Dry Matter Intake (DMI) based on their class and size. Class categories include Growing Kids, Nursing Does, Yearlings, Maintenance Goats (Open Does, Wethers, Bucks). DMI estimates are based on the weight of each goat, categorized by its class. According to Langston University meat goat data[1], growing kids consume 7.96% of their body weight in dry matter per day. Nursing does: 4.82%, Yearlings: 3.06%, Maintenance Goats: 2.04%. Adjust stocking rates based on composition of goat herd. Decrease stocking rate if nursing does and kids are used.

Growing calves, yearlings, late pregnancy and lactating beef cows not usually suited to Brush eradication because their nutrient requirements exceed the quality of the forage. Breeds of cattle most suited to brush management include Scottish Highlanders and Dexter. Expect total cattle intake of brush not to exceed 1% of body weight. Monitor body condition of cattle closely.

Brush Reduction or Eradication Strategies

Localized Infestations
Where the target species tend to be concentrated into smaller areas within a larger management unit, the total area will be subdivided into a minimum of three paddocks. Identify the paddock with the largest concentration of the target species and apply the most grazing pressure there. Defoliate to remove 80% of leaves and twigs of species targeted for removal. Estimate size of paddocks initially by stocking one goat per acre for each percent of browse cover. Adjust paddock sizes up or down by noting days it takes to achieve full defoliation. Move goats or other stock to the next paddock and repeat**. When the initial paddock leafs out again, regardless of where the goats are in the rotation, bring them back to the initial paddock to defoliate the brush again. Change stocking rates up or down to adjust for conditions.** Continue this until all paddocks have brush killed or suppressed to 80% defoliation. Killing brush may take 2 to 8 years of repeated browsing. Maintenance with goats should be applied in future years as needed. Browsing after August 15 does not result in control of brush species.

Target Species Evenly Distributed
Where the target species is distributed evenly across the control area a two paddock switchback system can be used. Start when leaves and twigs first emerge. Stock with enough goats to achieve at least 65% defoliation in 30 days. Move goats to the second paddock and defoliate to at least 65%. Repeat process until both paddocks have been defoliated to a minimum of 65%. Adjust stock density up or down as needed.

.Browse Management Strategies

Where the goal is to maintain browse, reduce stocking rates. Subdivide area into multiple paddocks and set initial stocking densities. Where grasses and forbs predominate, graze cattle and/or sheep along with the goats and develop a forage balance table to estimate stocking rates.

Considerations

Goat Grazing Preferences

Preferred species:
Box elder, buckthorn, autumn olive, honeysuckle, multiflora rose, blackberry, greenbrier, raspberry, gooseberry, locust, , willow, mulberry, wild grape, , gooseberry, chicory, red clover, ragweed, lambs quarter, curly dock, sericea lespedeza, crown vetch, white clover, red clover, black medic, birdsfoot trefoil, poison ivy/oak/sumac, aspen , pigweed, oak, walnut, cherry, agrimony, burdock, growing tips of most grasses.

Intermediate preference:
Cedar, buck brush, barberry, hickory, sumac, ironweed, lupine, spiny amaranth, Siberian elm , burning bush, prickly ash, pokeweed, buttercup, , thistle, , ox-eye daisy, queen anne's lace, milkweed, upright parts of green garlic mustard, spotted knapweed, leafy spurge, yellow and white prairie clovers.

Not preferred:
Common mullein, velvetleaf, foxtail, reed canarygrass, any dry/stemmy grass, basal or dry parts of garlic mustard, the bulk dry matter component of most grasses

Undesirable or potentially poisonous:

Horse nettle (poisonous), perilla mint, wooly croton, buffalo burr, wild cherry (okay if fresh, poisonous if wilted in large quantity without other forages available), Switchgrass (may cause photosensitivity), alsike clover (may cause liver damage)

Fence:

Use the Minnesota Conservation Practice Standard Fence (382) to construct boundary fencing when permanent fences are desired. Perimeter fences need to be 6 or more wire high tensile electrified fence if goats are the primary species. Woven wire fences with an electric offset wire may also be used. Woven wire alone or high tensile fence with a minimum of three electrified wires are used for permanent interior fence. Voltages between 4000 and 7000 volts are recommended for electric fence to contain goats. Portable electric net fences can substitute for permanent fences and are commonly used, especially for contract grazing.

Watering:

Goats eating dry forages will need approximately 2 gallons of water per day per hundred pounds of body weight. Goats may need no supplemental water when fresh forage is abundant, as is the case early in the growing season in the first day that goats are placed in a paddock that is managed to be defoliated within 4 days. Water intake will increase as lush vegetation availability decreases. Lactating does will consume more water than other classes of goats. Cattle and sheep will have higher water requirements than goats. Plan to supply 2 gallons per hundred pounds body weight per day.

Supplemental Feed

If goats are browsing intermediate preference species they may need supplemental energy or protein or a supplement containing the antidote to the secondary plant compounds that make the plant less desirable for consumption, particularly if they are young, growing animals or lactating. Mature dry nannies or mature wethers may be able to cope short-term with intermediate preference browse without supplementation. The herder needs to monitor the body condition of the animals frequently (no less than once per week).

Sheep Grazing Preferences

. **Sheep alone will not control brush. They must be used in combination with goats.** Sheep brush intake is much less than goats, especially wool breeds. If given free choice, they may take in approximately 10% of their diet as brush. Sheep consume more broadleaf weeds than either goats or cattle, as much as 30% of their diet. The remaining 60% is grass. The planner should use dietary preferences based on the plant community to be controlled. Wool sheep are less suited for brush control and will need supplemental feed if brush is their only forage. Hair sheep would be a second preference to goats for brush control, and approximately equal to Scottish Highland cattle. Siberian elm has been identified as one brush species that hair sheep will consume

Cattle Grazing Preferences

Cattle alone will not control brush. They must be used in combination with goats. Cattle graze brush less aggressively than either goats or sheep and prefer grasses over either forbs or brush. Scottish Highland cattle will browse brush more than other breeds and prefer aspen. Cattle need grass in their forage-based diet to provide sufficient digestible carbohydrates.

Multi-species Browsing

Where the invasive plants are a mix of woody and forb species, a combination of goats and hair sheep, with the percentage of each livestock species by daily DMI being reflective of the percent cover of each type of invasive, can be successfully managed together, or in leader-follower browsing. Likewise, if the invasive community is a mix of invasive brush and grass, goats with hair sheep, or goats with cattle, or goats with horses would be an ideal mix for controlling the invasive plants. Sheep are susceptible to accumulated copper toxicity, thus treatment of sheep with Molybdenum following exposure to high-copper mineral designed for goats or cattle is recommended.

Guard Animals or Protection:

Goat herds need protection from predators such as bears, wolves, coyotes and domestic dogs. The extent of protection depends on the concentration of predators. Means of protection include multi-strand, high tensile electrified fence with sufficient wires located near the potential point of intrusion and a minimum charge of 5000 volts. Dogs, Llamas, and donkeys may be used to guard sheep and goats. A tightly enclosed predator proof area to place sheep and goats overnight may be required depending on location and predator concentration

Biological Brush Management Plan

Client:	Date:	Planner:
County:	Location:	Contract #:

Plan Objectives

Determine whether the goal is to alter the plant community to provide sustainable browse or eradicate invasive species. Identify the desired species composition.

_____

_____

List Target Brush Species:

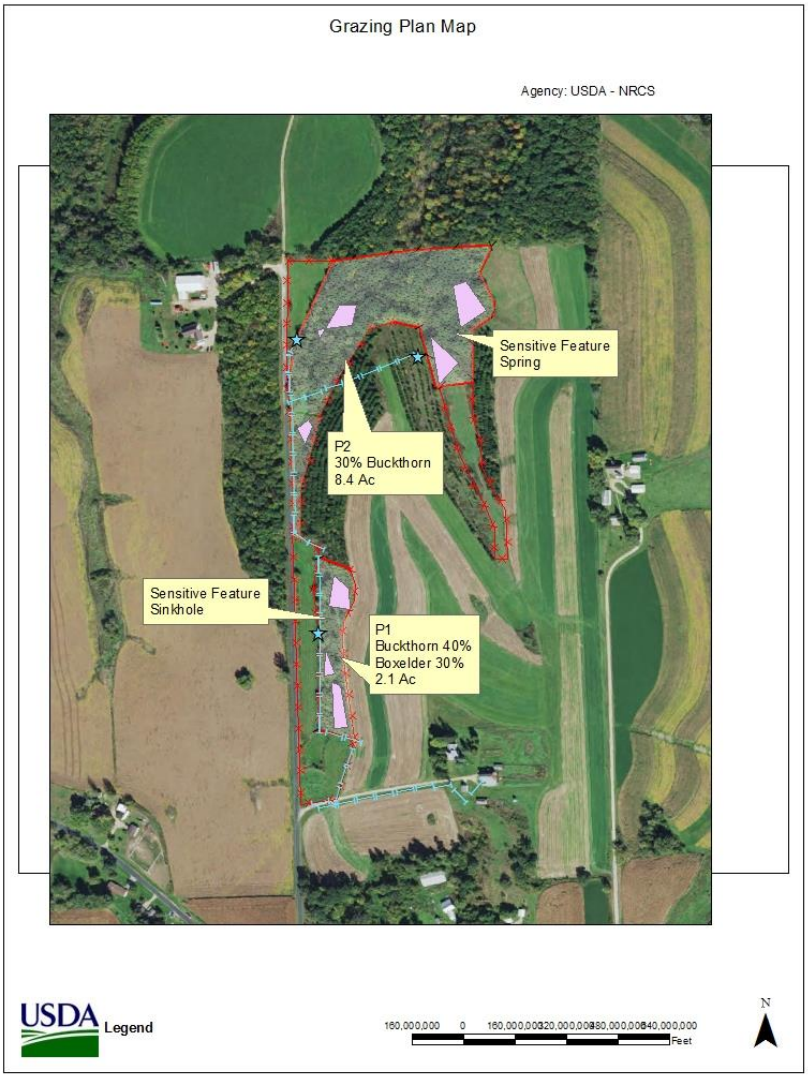
_____

_____

Brush Control Plan Details

Management Unit Name	Pasture/Management Goal	Acres	Target Species	Stocking Rate
Example 1	Brush Eradication	2.1	Buckthorn	60 goats
Example 2	Brush Eradication	8.4	Buckthorn	60 goats

Attach aerial photo labeled to show named management units. Management units will be defined by similar brush cover and concentration. On aerial photo show existing and planned fences, pipeline, watering facilities, and environmentally sensitive features (if applicable). Locate concentrations of invasive species. Identify desirable species. List target species for browsing. The sample map above shows the concentrations of Buckthorn in purple. Electric net fencing would be used to subdivide the area and concentrate grazing pressure.



Livestock Inventory

Kind/Class Animal	Number	Average Weight	Total Weight Group
Nanny Goats(example)	60	150	9000

Livestock Watering Plan

Estimate daily water use by animals and describe how water will be delivered. Formula for estimated daily water use is 2 gallon per hundred pounds of body weight. Example; 60, 150 pound goats weigh 9000 pounds as a group. 9000/100 = 90. 90 X 2 =180 gallons of water.

Kind/Class	Number	Ave. Body Wt.	Group Wt.	Est. Water Need
Wether goat	60	150	9000	180

Sensitive Features Plan

Describe the sensitive features (riparian areas, sinkholes, threatened and endangered species, steep areas, droughty soils, etc.) Locate them on the plan map and describe how they will be managed.

In sensitive areas containing desirable species, but areas with invasive shrubs, goat browsing in the dormant season can kill shrubs while avoiding negative impacts on the desirable plant species. Goats are capable of causing damage to thin-barked brush species after August and during the plant dormant season through girdling of bark. Species girdled by goats include: red cedar, buckthorn, autumn/Russian olive, sumac, small cherry, moderate box elders, moderate locust, small walnut, prickly ash. Species not readily girdled, but damaged by horn rubbing by goats include honeysuckle, barberry, buckbrush, and large grape vines.

Management Unit	Sensitive Feature Type	Management Recommendations

Management Considerations

When weather is colder than 40F and rain is predicted, goats need shelter. Describe in the plan how goats will be protected from cold, rainy conditions. Dry goats can handle up to -30F without wind or rain, but need shelter if temperatures are below 20F with wind. Goats cannot be outwintered with simple windbreaks like beef cattle or wool sheep. Describe in plan how goats and other livestock will be wintered on site if applicable. Describe how and where supplemental feed will be provided if applicable.

Monitoring Plan

Describe how the animal impact will be monitored and list criteria to move animals.

Management Unit	Management Objective	Action	Monitoring Frequency
Example 1	Remove 90% of leaves and new twig growth on all buckthorn as high as the animals can reach.	Remove animals once objective has been reached	Daily
Example 2	Remove 90% of leaves and new twig growth on all buckthorn as high as the animals can reach	Remove animals once objective has been reached.	Daily

Monitoring Report

The monitoring report describes the results of observations and measures progress implementing the plan. Monitor brush control daily. Observations will include the estimated percent of brush defoliation by species, bark stripping by species, any resource concerns in sensitive features, and any health issues in the grazing animals. The monitoring report will include data on species composition before the animals are turned out and when they are removed each year. See sample monitoring report below.

Date	Management Unit	Observations	Action
6/10	Example 1	Goats have removed around 50% of the buckthorn leaves up to the height they can reach	Keep goats in P1 until 90% of buckthorn leaves have been removed.
6/12	Example 1	90% removal achieved	Move to P2

Submit monitoring reports each year with monitoring results and a final monitoring report that describes the species composition and percent defoliation of each management unit.

Practice Specifications Approval and Completion Certification

NRCS Review Only

DESIGN INSTALLATION AND LAYOUT APPROVAL:

Designed By:	Date:	Job Approval Authority (JAA):
Checked By:	Date:	Job Approval Authority (JAA):
Approved By:	Date:	Job Approval Authority (JAA):

LANDOWNER/OPERATOR ACKNOWLEDGES:

a. They have received a copy of the specifications and understand the contents including the scope and location of the practice.
b. They have obtained all necessary permits and/or rights in advance of practice application, and will comply with all ordinances and laws pertaining to the application of this practice.
c. No changes will be made in the installation of the job without prior concurrence of the NRCS.
d. Maintenance of the installed work is necessary for proper performance during the life of the practice. The practice life is _____.

I have reviewed all specifications and agree to install as specified:

Landowner/operator name (type or print):		
Landowner/operator Signature:		Date:

RECORD OF COMPLETION AND CHECK OUT CERTIFICATION:

Treated Acres:	Date Completed by Client:	Date Certified:	Approver's Initials:

CERTIFICATION STATEMENT:

I certify that implementation of this conservation practice is complete, meets criteria for the stated purpose(s), and meets the NRCS conservation practice standard and specifications.

NRCS Signature:	Date:	Job Approval Authority (JAA):
Notes:		

References

National Range and Pasture Handbook: NRCS, Grazing Lands Technology Institute, 2003

Using Goats to Control Invasive Species ; Nolden, Cherrie; University of Wisconsin, Madison

Targeted Grazing Handbook; University of Idaho;

Prescribed Grazing with Goats; NRCS; Conservation Practice Information Sheet; IS-mo528-gg;2005