

LIVESTOCK GRAZING GUIDELINES FOR CONTROLLING NOXIOUS WEEDS IN THE WESTERN UNITED STATES



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A WESTERN REGION SUSTAINABLE AGRICULTURE, RESEARCH, AND EDUCATION PROJECT

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Introduction

Introduction

Invasion by exotic plant species is considered one of the most significant ecological threats of the modern era — rivaling ozone depletion, global warming, and loss of biodiversity. In western North America, noxious weeds such as spotted knapweed (*Centaurea maculosa*), leafy spurge (*Ephorbia esula*), yellow starthistle (*Centaurea solstitialis*), and rush skeletonweed (*Chondrilla juncea*) pose a significant threat to the environment. Their invasion into western wild lands often results in reduced biodiversity, increased soil erosion, degradation of wildlife habitat, and reduced carrying capacity for livestock.

Wildland weeds are difficult to control. Herbicides, insects, pathogens, cultural practices, and fire have not effectively contained the spread of many wildland weeds. A major challenge is the cost and feasibility of treating vast landscapes. Classical biological control, using insects and microbes, can be effective, but it is limited by ecological concerns and is time consuming to develop. An underexploited and readily available agent for weed control is domestic livestock.

Prescribed livestock grazing is the intentional use of livestock to achieve vegetation management goals. Many studies and established programs show that grazing weeds at a specific time, duration, and intensity can effectively reduce their abundance. The effectiveness of prescription grazing by sheep and goats has been clearly demonstrated in several western states for the management of leafy spurge, spotted knapweed, and yellow starthistle. Prescribed grazing can also be integrated with herbicides, fire, or traditional biocontrol methods to improve the efficacy and longevity of weed control treatments.

Prescribed grazing can damage weeds in several ways. Grazing in the early spring will remove new growth, requiring the plant to utilize root and crown reserves while significantly reducing photosynthesis and subsequent food production. If continued for long enough, the plant is weakened and may die. Grazing later in the spring can prevent flowering and seed formation, reducing the opportunity for seed production. Grazing the target weed during the growing season can stress the weed while allowing desirable plants to grow with reduced competition. Fall grazing can disrupt the flow of plant nutrients to the roots and crowns of the plant and, as a result, reduce carbohydrate reserves necessary for subsequent spring growth.

In some instances, noxious weeds can be excellent forage. For example, sheep and goats readily graze leafy spurge, do well on it, and select it over grass. In other situations, grazing animals might only graze noxious weeds as a last resort after all other forages have been consumed. In these instances, care must be taken to avoid long term damage to desirable vegetation. Maintaining a healthy population of desirable plants, such as perennial grass, is a key to controlling noxious weeds on a site.

While numerous studies and well-established programs clearly demonstrate the effective application of prescription grazing, it is an underutilized weed management

tool. Obstacles to its adoption include land managers' ignorance about potential application, lack of information related to animal production systems designed for vegetation management, limited familiarity with developing grazing prescriptions, and challenges in drafting contracts for vegetation management. Information on how to accomplish prescription grazing for vegetation management is currently available in a few scientific articles, book chapters, and symposia, but information provided by professional grazing practitioners has not been assembled.

Purpose

The purpose of this manual is to summarize information concerning the use of livestock to manage important noxious weeds in nine western states. It is not our intent to advocate livestock grazing as the only method of managing noxious weeds, but to promote livestock grazing as one of many tools that should be considered when developing a long-range, comprehensive, noxious weed management plan.

Methodology

A preliminary list of 66 weed species was compiled by reviewing noxious weed lists from California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming. Weeds were considered for this project if they appeared on at least two of the selected states' noxious weed lists. Three weed species occurred on all nine noxious weed lists, and 23 weeds only occurred on two states' lists. The compiled weed list is presented in Table 1.

A draft survey instrument of 27 questions was developed and reviewed by six individuals involved in utilizing livestock for weed control activities in six different states. Their comments and suggestions were incorporated into the final survey instrument. Two versions of the survey were developed — one for researchers and the other for grazing practitioners and weed managers. Appendix B presents a copy of the survey instrument used for grazing practitioners and weed managers.

A list of potential survey participants was developed by contacting every Cooperative Extension weed specialist in the target states. Other individuals were selected based on the authors' knowledge of professional weed managers located in the western states, articles in popular publications identifying individuals involved in weed management using livestock, and a practitioner list published on a website that is maintained by an individual involved in using livestock for vegetation management. The list was expanded during the survey period by including individuals recommended by "word of mouth" from survey respondents. The final list of potential respondents included 288 individuals. The survey was conducted over a five-month period and resulted in a 28 percent response rate (i.e., 80 returned surveys).

The information used to develop grazing guidelines came from two sources. The first was a survey administered over the phone and by email to individuals who were: a) researchers experienced in using livestock as a weed management tool, b) grazing

practitioners who utilize livestock in commercial vegetation management enterprises, or c) weed management professionals who had experience in the use of livestock to manage weeds. The second sources were research reports, university or agency fact sheets, websites, and referred journal articles. Grazing guidelines were developed for 26 species for which literature or survey data provided evidence of the effectiveness of livestock grazing as a management tool. The grazing guidelines are a melding of the information reported in the literature and survey, combined with the knowledge of the authors. The literature used to compile this manual is in Appendix A.

While there is a large amount of information available in the popular or non-scientific press concerning the benefits of using livestock as a weed control tool, very little of what is published can be authenticated with any level of scientific vigor. Therefore, we chose to ignore this source of information. The authors recognize that the survey respondents could have an economic incentive to support livestock grazing as a weed management tool and noted in the grazing guidelines when the survey responses conflicted with the scientific literature.

Table 1. Plants listed as noxious weeds for at least two western states in order of occurrence by the number of states in which they occur.

Species	CA	CO	ID	MT	NV	OR	UT	WA	WY	Total
Diffuse knapweed (<i>Centaurea diffusa</i>)	X	X	X	X	X	X	X	X	X	9
Leafy spurge (<i>Euphorbia esula</i>)	X	X	X	X	X	X	X	X	X	9
Spotted knapweed <i>Centaurea maculosa</i>)	X	X	X	X	X	X	X	X	X	9
Dalmatian toadflax (<i>Linaria genistifolia</i> ssp. <i>dalmatica</i>)	X	X	X	X	X	X		X	X	8
Musk thistle (<i>Carduus nutans</i>)	X	X	X		X	X	X	X	X	8
Russian knapweed (<i>Acroptilon repens</i>)		X	X	X	X	X	X	X	X	8
Scotch thistle (<i>Onopordum acanthium</i>)	X	X	X		X	X	X		X	7
Canada thistle (<i>Cirsium arvense</i>)		X	X	X		X	X		X	6
Dyer's woad (<i>Isatis tinctoria</i>)			X		X	X	X	X	X	6
Hoary cress (<i>Lepidium draba</i>)		X	X	X		X	X		X	6
Houndstongue (<i>Cynoglossum officinale</i>)		X		X	X	X		X	X	6
Perennial pepperweed (<i>Lepidium latifolium</i>)		X	X			X	X	X	X	6
Purple loosestrife (<i>Lythrum salicaria</i>)			X		X	X	X	X	X	6
St. Johnswort (<i>Hypericum perforatum</i>)		X		X	X	X		X	X	6
Yellow toadflax (<i>Linaria vulgaris</i>)		X	X	X	X	X			X	6
Field bindweed (<i>Convolvulus arvensis</i>)			X	X		X	X		X	5
Rush skeletonweed (<i>Chondrilla juncea</i>)	X		X		X	X		X		5
Sulfur cinquefoil (<i>Potentilla recta</i>)		X		X	X	X		X		5
Yellow starthistle (<i>Centaurea solstitialis</i>)			X		X	X	X	X		5
Common crupina (<i>Crupina vulgaris</i>)			X		X	X		X		4
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)		X			X	X		X		4
Johnsongrass (<i>Sorghum halepense</i>)			X			X	X	X		4
Meadow hawkweed (<i>Hieracium</i> spp.)			X	X		X		X		4
Oxeye daisy (<i>Chrysanthemum leucanthemum</i>)		X		X				X	X	4
Perennial sowthistle (<i>Sonchus arvensis</i>)	X		X					X	X	4

Table 1. Plants listed as noxious weeds for at least two western states. (continued)

Plumeless thistle (<i>Carduus acanthoides</i>)	X	X					X	X	4
Quackgrass (<i>Elytrigia repens</i>)		X				X	X	X	4
Saltcedar (<i>Tamarix ramosissima</i>)		X				X		X	4
Biddy-biddy (<i>Acaena novae-zelandiae</i>)	X					X	X		3
Camelthorn (<i>Alhagi maurorum</i>)	X				X			X	3
Common tansy (<i>Tanacetum vulgare</i>)		X		X				X	3
Hydrilla (<i>Hydrilla verticillata</i>)	X				X			X	3
Iberian starthistle (<i>Centaurea iberica</i>)	X				X			X	3
Meadow knapweed (<i>Centaurea x moncktonii</i>)			X			X		X	3
Mediterranean sage (<i>Salvia aethiopsis</i>)					X	X		X	3
Medusahead (<i>Taeniatherum caput-medusae</i>)					X	X	X		3
Orange hawkweed (<i>Hieracium aurantiacum</i>)		X	X					X	3
Puncturevine (<i>Tribulus terrestris</i>)			X			X		X	3
Scotch broom (<i>Cytisus scoparius</i>)	X		X			X			3
Squarrose knapweed (<i>Centaurea virgata</i>)	X				X		X		3
Syrian bean caper (<i>Zygophyllum fabago</i>)	X		X		X				3
Tansy ragwort (<i>Senecio jacobea</i>)									
Yellow nutsedge (<i>Cyperus esculentus</i>)		X				X		X	3
Black henbane (<i>Hyoscyamus niger</i>)	X		X						2
Buffalobur (<i>Solanum rostratum</i>)			X					X	2
Bull thistle (<i>Cirsium vulgare</i>)		X				X			2
Common bulgloss (<i>Anchusa officinalis</i>)						X		X	2
Cutleaf teasel (<i>Dipsacus laciniatus</i>)		X				X			2
Garlic mustard (<i>Alliaria petiolata</i>)						X		X	2
Goatsrue (<i>Galega officinalis</i>)					X			X	2
Gorse (<i>Ulex europaeus</i>)						X		X	2
Halogeton (<i>Halogeton glomeratus</i>)	X					X			2
Italian thistle (<i>Carduus pycnocephalus</i>)						X		X	2
Japanese knotweed (<i>Polygonum cuspidatum</i>) and Himalayan knotweed (<i>Polygonum polystachyum</i>)		X						X	2
Jointed goatgrass (<i>Aegilops cylindrica</i>)			X			X			2
Kochia (<i>Kochia scoparia</i>)						X		X	2
Mayweed chamomile (<i>Anthemis cotula</i>)		X			X				2
Milk thistle (<i>Silybum marianum</i>)						X		X	2
Poison hemlock (<i>Conium maculatum</i>)			X			X			2
Purple starthistle (<i>Centaurea calcitrapa</i>)					X			X	2
Silverleaf nightshade (<i>Solanum elaeagnifolium</i>)			X					X	2
Slender flowered thistle (<i>Carduus tenuiflorus</i>)						X		X	2
Spanish broom (<i>Spartium junceum</i>)						X		X	2
Texas blueweed (<i>Helianthus ciliaris</i>)	X							X	2
Velvetleaf (<i>Abutilon theophrasti</i>)						X		X	2

The information base concerning the use of livestock as a weed management tool is constantly changing. This manual is a “snapshot” of the knowledge that existed as of 2006. The reader is encouraged to visit <http://www.cnr.uidaho.edu/rx-grazing/index.htm> for the most up-to-date information on the use of livestock to control noxious weeds.

Additional considerations when using livestock in a weed control program

Grazing noxious weeds with livestock requires a manager to consider additional complicating factors that may not be present under normal grazing programs. These factors include transfers of weed seed by livestock, considerations related to scale of the project, and animal behavior issues related to weedy plant selection and use, and avoiding damage to desirable species.

Weed seeds – Research has clearly shown that some weed seeds will pass through the digestive tracts of grazing animals whenever they consume plants containing viable seed. The digestive process kills or reduces germination of some species while others pass through relatively unaffected. The potential damage to weed seeds from the digestive process and time it takes for a seed to pass through an animal is dependent on several factors including the size and shape of the seed, species of grazing animal, and type of plants consumed. As such, livestock that are being used to graze noxious weeds when the plants are flowering must be quarantined for a period of time and fed weed-free forage before moving them to any location that is weed free. The amount of time mentioned in the literature ranges from a minimum of 5 to upwards of 14 days. Most experienced managers recommend a quarantine period of 7 to 10 days. Weed seed can also be spread in wool and hair. Again, the danger of spreading weeds in this manner depends on the type of animal being used and the shape of the weed seeds being grazed. This fact must be taken into consideration when deciding whether to use livestock in a weed control program

Scale -- Livestock grazing for the management of noxious weeds is similar to other tools in that, the larger and more dense the weed infestation is before treatment starts, the more difficult the treatment becomes. Treating larger, more dense areas require more livestock as the optimum treatment time remains relatively constant and more livestock require more fencing, herders, water, guard dogs, etc. More importantly, larger herds of livestock require greater amounts of forage when not grazing noxious weeds as they cannot be stored until needed like equipment can. Therefore, treating small infestations is normally beneficial as with other weed management tools.

Livestock behavior -- Some livestock species are more adapted to grazing weedy plants than others. However, there are a number of reasons that animals may show little or no preference for certain plants. Some plants may not be grazed because: 1) the animals have no experience with the plant and have no good reason to try it, 2) the plant contains relatively high levels of a toxin, 3) the plant is defended physically by awns, thorns, spines, or some other deterrent to being grazed, or 4) the plant is low in digestibility or nutrients at maturity like medusahead.

Managers using grazing behavior principles can help animals overcome their avoidance of weeds. Some behavior related considerations include the following:

1. Experienced lead animals can facilitate grazing of some weeds by inexperienced animals. Mothers provide the primary influence on the diet preferences of their offspring by what they eat and where they go. Other animals in a herd have an influence as well. A herd of animals that utilize target weeds can be developed by choosing replacements from animals that readily graze the target plant.
2. Stocking at high densities (animals per acre) for short periods of time encourages animals to graze much less selectively. By doing this, choices on what to graze are reduced and all animals begin to graze some of the less preferred plants along with more preferred forage plants. For instance, leafy spurge is known to be readily eaten by sheep and goats. There is also evidence that cattle at high stock densities have controlled it in Nebraska when spurge occurred in isolated patches alongside more desirable forage species.
3. Supplemental feeds can increase intake of less preferred plants. Some weedy plants are not grazed because they are high in toxic compounds such as terpenes, tannins, oxalates, alkaloids, or other compounds. Supplemental feed can reduce the effects of some toxins by causing the toxin to be tied up and excreted. Forcing animals to eat weedy plants containing toxins can actually reduce intake of the target weed and increases stress on the animals. Most plants have been analyzed, toxic compounds they contain have been identified, and the information published. It pays to know what compounds in a plant may be causing animals to avoid grazing it.

Avoiding damage to palatable plants -- Grazing noxious weeds when palatable, desirable plants are present is possible. It may be possible to affect grazing preference by changing the class and type of livestock, season of livestock use, or stocking rate. The use of grazing systems, such as short duration-high intensity grazing schemes, which allow for temporary heavy defoliation of desirable plants coupled with a period of non-use for re-growth may also be useful. Properly planned, grazing systems can allow livestock to safely utilize desirable plants, while also damaging noxious weeds. Regardless of the tack taken, the effects of livestock grazing on desirable plants should be monitored.

How to use these grazing guidelines

The guidelines presented in this manual represent the “best judgments” of the authors based primarily on an evaluation of the literature and survey results. This information was supplemented by their personal knowledge and experience. The guidelines are not meant to be a static prescription to be applied whenever the particular weed is encountered, but to provide guidance to managers who are faced with management of noxious weeds and are considering using livestock as a tool in their management program.

Adequate information was available to develop grazing guidelines for 26 of the 67 weed species listed as noxious by at least two western states. Table 2 summarizes grazing

guidelines and information sources by noxious weed for the 27 species. The remaining 40 weeds had insufficient information available to develop a guideline for using livestock as a management tool. That does not mean that livestock should not be considered as a tool for these weeds — only that more information needs to be available before a guideline can be prepared.

The guidelines are presented in table format according to 16 topics. If information was lacking for a particular topic, “NI” (No Information) was used. The grazing guideline topics are explained below.

Weed name: Common name of the noxious weed discussed in the grazing guideline.

Animal type: Domestic animal species most useful in controlling the weed species.

Animal class: The recommended class of animal to be used.

Growth stage for treatment: The growth stage of the target weed when livestock are most useful as a management tool.

Palatability: The growth stage of the target weed most acceptable to grazing animals or when preference for the plant is greatest.

Effectiveness of grazing treatment: Information about the potential effectiveness of grazing as a weed management tool.

Plant response: Information about the response of the target weed to the recommended grazing prescription.

Table 2. Summary of grazing guidelines and information source by noxious weed species.

Noxious Weed Common Name (<i>Scientific Name</i>)	Animal Type				Source of Information	
	Sheep	Goats	Cattle	Horses	Number of Surveys	Literature
Canada thistle (<i>Cirsium arvense</i>)	✓	✓	✓	NR	5	Yes
Common tansy (<i>Tanacetum vulgare</i>)	✓	✓	☠	NR	1	Yes
Dalmatian toadflax (<i>Linaria genistifolia</i> ssp. <i>dalmatica</i>)	✓	✓	NR	NR	2	Yes
Diffuse knapweed (<i>Centaurea diffusa</i>)	✓	✓	✓	NR	5	Yes
Dyer's woad (<i>Isatis tinctoria</i>)	✓	✓	NR	NR	1	Yes
Gorse (<i>Ulex europaeus</i>)	✓	✓	NR	NR	0	Yes

Table 2. Summary of grazing guidelines and information source by noxious weed species. (continued)

Hoary cress (<i>Lepidium draba</i>)	NR	NR	NR	NR	2	Yes
Japanese knotweed (<i>Polygonum cuspidatum</i>) and Himalayan knotweed (<i>Polygonum polystachyum</i>)	NR	MS	NR	NR	1	No
Kochia (<i>Kochia scoparia</i>)	✓	✓	✓	NR	0	Yes
Leafy spurge (<i>Euphorbia esula</i>)	✓	✓	☠	☠	14	Yes
Medusahead (<i>Taeniatherum caput-medusae</i>)	✓	✓	✓	NR	1	Yes
Musk thistle (<i>Carduus nutans</i>)	✓	✓	✓	NR	1	Yes
Perennial pepperweed (<i>Lepidium latifolium</i>)	✓	✓	✓	NR	5	Yes
Poison hemlock (<i>Conium maculatum</i>)	☠	☠	☠	☠	1	Yes
Purple loosestrife (<i>Lythrum salicaria</i>)	NR	NR	MS	NR	0	Yes
Purple starthistle (<i>Centaurea calcitrapa</i>)	NR	✓	NR	NR	0	Yes
Quackgrass (<i>Elytrigia repens</i>)	✓	✓	✓	✓	0	Yes
Rush skeletonweed (<i>Chondrilla juncea</i>)	✓	NR	✓	✓	2	Yes
Russian knapweed (<i>Acroptilon repens</i>)	✓	✓	NR	☠	5	Yes
Scotch broom (<i>Cytisus scoparius</i>)	✓	✓	NR	NR	0	Yes
Scotch thistle (<i>Onopordum acanthium</i>)	✓	✓	✓	NR	4	Yes
Spanish broom (<i>Spartium junceum</i>)	NR	MS	NR	NR	0	Yes
Spotted knapweed (<i>Centaurea maculosa</i>)	✓	✓	NR	NR	9	Yes
Tansy ragwort (<i>Senecio jacobaea</i>)	✓	NR	☠	☠	1	Yes
Yellow starthistle (<i>Centaurea solstitialis</i>)	✓	✓	✓	☠	9	Yes
Yellow toadflax (<i>Linaria vulgaris</i>)	NR	MS	NR	NR	1	Yes

✓ Suitable for livestock grazing

NR Not recommended by the authors.

☠ Poisonous to livestock.

MS Marginally suitable for livestock grazing

Grazing objective: Information for planning grazing duration, intensity, and utilization levels.

Number of treatments per year: Information about the number of grazing treatments per year, for effective control.

Number of treatment years: Information about the minimum number of years the treatment needs to be conducted, for effective control.

Practicality of method: Information concerning how practical livestock use is for managing the target weed and limitations to the use.

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***Noxious Weed Descriptions
and Grazing Guidelines***

Canada thistle

(Cirsium arvense)



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Description:

Canada thistle is a perennial plant that grows from a vigorous, spreading root system. It is usually found growing in thick patches that eventually exclude all other plants. It grows up to 4 feet tall, with many branches growing from a heavily ridged stem. The leaves grow in an alternate pattern along the stems. They are normally oblong in shape with numerous spine-tipped lobes produced on the leaf edges. The leaves grow directly from the stalks without any stems. Several purple or occasionally white flowers grow from the tops of each stem. The flowers are small (about 1 inch long and 0.5 inches wide) with a miniature artichoke-like structure below the colored petals. Numerous, wire-like flower petals are attached to the fruits. The petals turn tan to white in color as the seed heads mature. The seeds are small, smooth, and light brown in color.

Canada thistle

Animal type	Sheep.	Goats.	Cattle.
Animal class	All classes.		Cows, calves, and yearlings.
Growth stage for treatment	Seedling through vegetative stages.	All stages.	Seedling, early vegetative stages.
Palatability	Readily consumed when plants are young, but declines with age.	Readily consumed in all growth stages.	Readily consumed when plants are young, declines with age.
Effectiveness of grazing treatment	Can be effective if grazed repeatedly over several years. Graze often enough to prevent flowering and seed production. Goats are the most effective animal.		Cattle are less effective than sheep and goats.
Plant response	Repeated grazing results in reduction of plant vigor, size, and flowering.		
Grazing objective	Begin grazing in spring when rosettes start to sprout. Remove animals when grazing shifts to desirable species, then graze new sprouts.		
Number of treatments per year	Graze often enough to prevent flowering.		
Number of treatment years	Grazing treatment should be repeated annually for at least three years.		
Practicality of method	Rated as somewhat to very practical, depending on ability to tightly control grazing and avoid damage to desirable species.		
Recommendation as a control method	Strongly to somewhat strongly recommended for controlling Canada thistle.		
Potential integration with other control methods	Recommended to be used in conjunction with herbicide treatments.		
Source of information	Surveys (5); Literature (3).		
Comments	General agreement between literature and survey respondents. However, literature indicates less long-term damage to plants than survey respondents.		
Summary	Goats, sheep, and cattle can damage Canada thistle with repeated grazing that prevents flowering. Goats are the preferred grazing animal, followed by sheep and then cattle. Sheep and cattle prefer to graze this plant when it is young and spines have not yet developed. Grazing works best when combined with herbicide treatment.		

Common tansy

(Tanacetum vulgare)



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Description:

Common tansy is a perennial plant that grows from 1 to 6 feet tall. It grows from seeds and creeping roots. Single stems grow from the roots and become multi-branched on the upper portion of the plant. The stems are mostly smooth and often purplish-red in color with numerous small glands. The leaves grow in an alternate pattern on the stems. They are composed of numerous leaflets that grow from both sides of a central stalk. The leaflets are long and narrow and have deeply scalloped edges, giving the plant a feathery appearance. They become smaller toward the top of the plant and have a strong odor when crushed. The flowers are about 0.5 inches across, resemble buttons, and are produced in numerous flat-topped groups on the ends of the uppermost stems. They are bright yellow in color, round, flat, and have no obvious petals. The seeds are small, yellowish-brown in color, and have a five-toothed crown on one end. The roots of common tansy spread widely, grow near the soil surface, and are able to produce a new plant from very small pieces.

Common tansy

Animal type	Sheep.	Goats.
Animal class	Yearling sheep and goats.	
Growth stage for treatment	Bolting to early flower stages.	
Palatability	Not very palatable (even to goats). Livestock usually need to be confined and stocked at a high density on common tansy infested areas.	
Effectiveness of grazing treatment	Grazing can be effective if timed correctly to prevent re-growth and flowering.	
Plant response	Grazing reduces plant vigor, size, and flower production.	
Grazing objective	Reduce biomass and density, allowing competitive vegetation to increase.	
Number of treatments per year	Requires two or more grazing treatments per year.	
Number of treatment years	Grazing for at least 4 consecutive years is needed to reduce populations.	
Practicality of method	Not very practical due to cost and herding requirements. Common tansy populations are usually small and scattered, which requires frequent transport of livestock.	
Recommendation as a control method	Livestock must be confined on common tansy-infested areas and forced to graze it.	
Potential integration with other control methods	Grazing can be effective when combined with herbicide treatments.	
Source of information	Surveys (1); Literature (1).	
Comments	Common tansy has poor nutritive value. Yearlings are most effective at controlling this plant.	
Summary	Graze common tansy in the bolting to flowering stage. Goats are preferable to sheep; common tansy can be toxic to cattle, but goats can tolerate the plant chemistry.	

Dalmation toadflax

(*Linaria genistifolia* ssp. *dalmatica*)



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Description:

Dalmatian toadflax is a colorful perennial plant that grows up to 3 feet tall. It reproduces from seeds and roots. The leaves are heart shaped, packed tightly together, and grow around the main stem of the plant. They are a blue-green color, waxy to the touch, and grow in an alternate pattern on the stem. The flowers are bright yellow with a long spur protruding from the rear. They have an orange area on the lower surface of the petals and resemble the flowers of a snapdragon. The flowers develop from the base of the leaves and grow from the middle of the summer until the fall.

Dalmation toadflax

Animal type	Sheep.	Goats.
Animal class	Ewes and lambs.	Yearling goats, kids, and does.
Growth stage for treatment	Seedling to flowering stages.	
Palatability	Sheep and goats may be reluctant to graze it at first. They readily consume dalmation toadflax after learning to graze it.	
Effectiveness of grazing treatment	Grazing can be somewhat to very effective in removing top growth in the short term. Long-term effectiveness of grazing is not known.	
Plant response	Grazing strips foliage, reduces seed production, and generally suppresses plants.	
Grazing objective	Graze dalmation toadflax at heavy to severe utilization levels to prevent seed development.	
Number of treatments per year	Multiple grazing treatments per year are preferred, including late season grazing.	
Number of treatment years	Conduct grazing treatment annually for at least 3 years.	
Practicality of method	Considered somewhat to very practical. It is dependent on time of year and labor requirements. Grazing is cheaper than chemicals and puts weight on lambs.	
Recommendation as a control method	Grazing is very strongly recommended as a control method by survey respondents.	
Potential integration with other control methods	Integration with all control methods is possible.	
Source of information	Surveys (2); Literature (2).	
Comments	Animal condition improved or was maintained by grazing dalmation toadflax. Preference for grazing it increases after a 2-year learning period.	
Summary	Both sheep and goat condition improves when consumed in the spring. Not known how long it takes for control, but at least 3 years of heavy to severe grazing is probably necessary.	

Diffuse knapweed

(*Centaurea diffusa*)



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Description:

Diffuse knapweed can grow as an annual, biennial, or short-lived perennial. It grows up to 3 feet tall with a single stem that produces numerous branches, giving the plant a bushy appearance. Plants reproduce entirely by seed. The seedling and basal leaves are covered with short hairs and are long (6") and thin. The leaves remain long and thinly divided at the base of the stem but become smaller and smooth towards the top. The stem is rough to the touch. Solitary flower heads are produced at the tips of the branches. The flowers are normally white but can take on a pinkish color. The modified leaves under the flower petals are small and yellowish-green colored, producing light-brown, comb-like margins. The upper portion narrows into short, stiff spines. The seeds are brown to grey and tipped with a light colored plume that drops off when the seeds are ripe.

Diffuse knapweed

Animal type	Sheep.	Goats.	Cattle.
Animal class	All Classes.		Cows, calves, and heifers.
Growth stage for treatment	Seedling, rosette, and bolting stages.	All growth stages to flowering.	Seedling to early bolting stages.
Palatability	Sheep and goats readily consume the diffuse knapweed when plants are young. Palatability declines as plants age.		Readily consume plants when young. Plants are much less palatable after bolting stage.
Effectiveness of grazing treatment	Grazing can reduce plant populations if grazed often enough to prevent flowering for several years. Grazing must be tightly controlled to avoid damage to desirable species.		
Plant response	Plant vigor, size, and flower production is reduced.		
Grazing objective	Graze heavily at least twice each year to prevent flowering and over several years to reduce plant populations.		
Number of treatments per year	A minimum of two grazing periods is necessary to prevent seed formation.		
Number of treatment years	Grazing for a minimum of three years is required to reduce populations.		
Practicality of method	Survey respondents reported grazing to be practical if adequate control and management of livestock is achieved.		
Recommendation as a control method	Graze this weed heavily during the bolting stage. Remove livestock for approximately two weeks and re-graze to prevent seed head formation.		
Potential integration with other control methods	Grazing is most effective when combined with herbicide treatments.		
Source of information	Surveys (4); Literature (5).		
Comments	General agreement between survey respondents and literature survey results.		
Summary	Diffuse knapweed is readily grazed by sheep, goats, and cattle up through the early vegetative stages. Palatability is reduced as the plant ages, especially for sheep and cattle. This species is not as palatable as spotted knapweed. Control depends on the prevention of flower and seed production. Grazing treatment must be applied at least twice a year for several years to be effective.		

Dyer's woad

(*Isatis tinctoria*)



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Description:

Dyer's woad can grow as an annual, biennial, or short-lived perennial plant. It normally begins growth in the fall or early spring from a seed with leaves that grow low to the ground in a circular pattern. The seedlings' leaves have fine hairs, are twice as long as they are wide, have smooth edges, and are widest near the tip. They have a large cream-colored vein running up the middle of the leaf. The plant can reach 4 feet tall, with several branches growing from the base. The leaves grow in an alternate pattern along the stem, are a bluish-green color, and have the same prominent vein as the seedling leaves. Dyer's woad flowers in April to June, depending on the location where the plants are growing. Numerous, small, bright yellow flowers grow in flat-topped groups on the end of each branch. The individual flowers have 4 petals. Each seed grows in a thin, flat pod that turns a deep purple to black color as it ripens. These groups of seed pods are very distinctive, and previous years' pods, hanging from the dead top growth, can often be used to identify this plant before it produces much growth in the spring.

Dyer's woad

Animal type	Sheep.	Goats.
Animal class	Wethers, ewes, and does.	
Growth stage for treatment	Seedling to early flowering stages.	
Palatability	Very little information is available concerning palatability of this plant. Palatability probably is highest during pre-flowering and drop rapidly after that time.	
Effectiveness of grazing treatment	Some indication that clipping or grazing the plant at least three times early in the growth period or a single clipping at flowering can be effective in reducing plant populations.	
Plant response	Repeated moderate to heavy levels of grazing can reduce the ability of dyer's woad to flower or even kill existing plants if timed properly.	
Grazing objective	Heavily graze dyer's woad soon after stem elongation and repeat the process to prevent flowering without harming desirable plant species.	
Number of treatments per year	A minimum of 3 early season grazing treatments (before flowering) or 1 heavy, late-grazing treatment (through flowering) per year.	
Number of treatment years	Grazing treatments should continue for at least 2 years.	
Practicality of method	Probably not very practical due to the low palatability of dyer's woad as the plants mature.	
Recommendation as a control method	Sheep or goats can be used to reduce top growth until flowering stage. Repeated grazing will reduce plant populations.	
Potential integration with other control methods	Grazing may be useful when integrated with mechanical treatments and herbicides.	
Source of information	Surveys (1); Literature (4).	
Comments	The survey respondents and literature results disagree on palatability of dyer's woad and effectiveness of grazing as a control method. The survey respondents were more supportive of grazing as a treatment method.	
Summary	Grazing sheep or goats may be useful in controlling dyer's woad if the plant is repeatedly defoliated (at least 3 times) from emergence to flowering stages over a 2-year period. Because of the relatively low palatability, the treated area should be monitored closely to avoid grazing damage to desirable species.	

Gorse

(Ulex europaeus)



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Description:

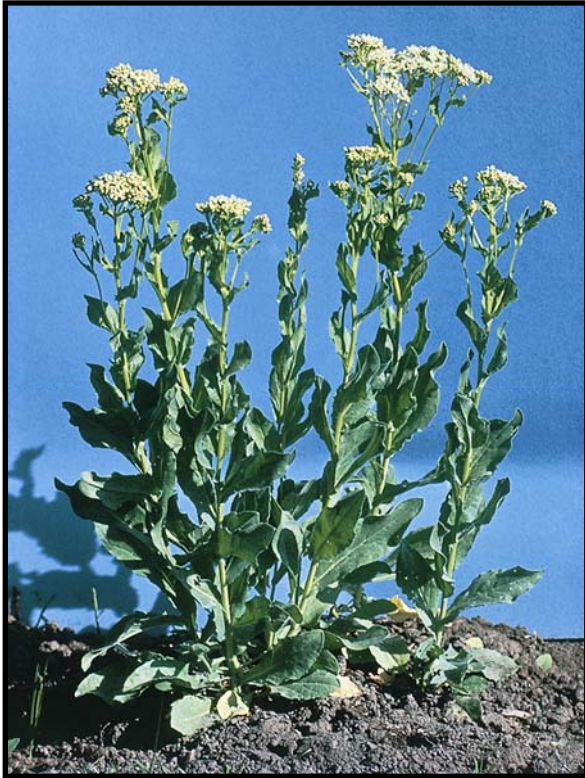
Gorse is a spiny, perennial, evergreen shrub with many branches that can grow to more than 10-feet tall and nearly as wide. The seedlings of gorse produce small leaves with three distinct tips similar to alfalfa and other legumes. As the plant matures, it produces many woody branches that are completely covered with spines. The spines are actually modified leaves and can be more than 3 inches long with sharp tips. Additional smaller spines grow from where the leaves and branches meet. The branches are angular and often die in the center of the plant. The flowers are bright, shiny yellow, and pea-like in shape. They grow densely along the branch tips or in clusters on short side stalks. When in full bloom, the plant can be completely covered with these bright yellow blossoms. Hairy seed pods 0.5 to 0.75 inches long are produced and turn brown as they ripen. The pods burst open and can scatter the seeds over a large area. The seeds are shiny, smooth, and greenish-brown in color.

Gorse

Animal type	Sheep.	Goats.
Animal class	NI.	
Growth stage for treatment	Preferred treatment stage is when new shoots and seedlings are soft.	
Palatability	Sheep do not eat gorse as readily as goats. Graze in conjunction with other plants.	Goats have a preference for young gorse shoots and seedlings. They will eat shoots that are up to 4 years old.
Effectiveness of grazing treatment	Sheep are not as effective as goats in controlling gorse.	Very effective when done in conjunction with burning or cutting and burning
Plant response	Grazing can reduce plant size, and density, and possibly eliminate gorse.	
Grazing objective	Graze sprouts after cutting and/or burning to deplete root reserves and increase consumption of seedlings.	
Number of treatments per year	Repeated grazing to prevent development of sprouts and establishment of seedlings. One report recommended a 4-pasture rotational scheme.	
Number of treatment years	Treatments should be repeated for 3-5 years to deplete root reserves and exhaust seedbank.	
Practicality of method	Sheep grazing is considered less practical than goat grazing.	
Recommendation as a control method	Recommended when used in conjunction with goats.	Highly recommended.
Potential integration with other control methods	Burning or cutting and burning are usually necessary pre-treatments for mature gorse stands. There was one report of cattle being used to knock down mature gorse plants.	
Source of information	Literature (5).	
Comments	Maintaining a healthy perennial grass understory to prevent gorse seedling establishment is key to long-term control.	
Summary	Gorse can be effectively controlled and ultimately eliminated by grazing goats after mature plants are cut and/or burned. Goats typically consume resprouts and seedlings.	

Hoary cress

(*Lepidium draba*)



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Description:

Hoary cress is a perennial plant up to 2 feet tall but often much shorter. It grows from seeds and a deep spreading root system. The seedling and basal leaves begin growth early in the spring, are grey-green in color, and have short stems. The leaves are produced in large colonies from the spreading root system. The leaves are much longer than they are wide, with rounded tips and smooth to slightly toothed edges. The leaves growing from the stems do not have stalks, clasp the stems, and grow in an alternate pattern. The rear of the leaves clasps the flower-producing stems. The flowers are white, very small, and have four petals. They grow in flat-topped, tight clusters, blooming in early spring. The individual seed pods are heart shaped and produce two reddish-brown seeds in each pod.

Hoary cress

Animal type	Sheep.	Goats.	Cattle.
Animal class	Ewes and lambs.	Does and kids.	Cows.
Growth stage for treatment	Best to graze hoary cress before flowering stage.		
Palatability	Palatability is considered to be low with most grazing animals and drops as the plant flowers and matures.		Cattle will consume the plant, but glucosinolates in high concentrations may be toxic.
Effectiveness of grazing treatment	There is little information available on effectiveness. Survey results range from ineffective to very effective. The literature is also inconclusive.		
Plant response	Repeated grazing may reduce plant vigor and flower production. The literature suggests similar damage achieved with repeated mowing.		
Grazing objective	The objective is to prevent flowering and remove as much top growth as possible on a repeated basis.		
Number of treatments per year	As with all deep-rooted perennial plants, the treatments would have to be repeated at least 2 times per year.		
Number of treatment years	Literature indicates at least 3 years of plant disturbance is necessary to reduce populations.		
Practicality of method	Probably not practical due to low acceptance of the plant by livestock and the potential for poisoning or tainting of the meat and milk.		
Recommendation as a control method	Survey results range from weakly to strongly recommend grazing as a control method. The literature does not recommend grazing..		
Potential integration with other control methods	Grazing may be useful when combined with herbicides or non-tillage mechanical control methods.		
Source of information	Surveys (2); Literature (6).		
Comments	Survey respondents were in disagreement as to effectiveness. The literature indicates caution should be used due to potential toxicity problems.		
Summary	Sheep and goats will consume hoary cress more readily than cattle. However, no solid information is available in the literature or from survey results that lead to the recommendation of grazing as a management tool for hoary cress at this time.		

Japanese knotweed and

(*Polygonum cuspidatum*)

Himalayan knotweed

(*Polygonum polystachyum*)



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Description:

The two knotweed species described here are similar in appearance except that Himalayan knotweed is normally smaller and has a much narrower leaf. These knotweeds are large, spreading perennial plants that grow in clumps from 6 to 10 feet tall. They reproduce by seeds and spreading underground stems. These plants die back each winter, and new shoots grow up through the old stalks, which resemble bamboo. New stems are thick, red, and somewhat resemble asparagus spears. The stems are distinctive in that they are thick, hollow, woody, and jointed. Normally, they are reddish brown in color and always have papery sheaths surrounding the joints, which appear to be somewhat swollen. The leaves grow in an alternate pattern on the stems and are at least 2 or more inches in length, egg-shaped with squared-off bottoms, and have a sharp, pointed tip. Himalayan knotweed leaves are narrower and more lance shaped than Japanese knotweed. The flowers of these knotweeds are normally white to cream-colored, but Himalayan knotweed flowers can be a pinkish shade. The flowers grow in large, lacy clusters from the ends of the stems or where the leaves meet the stems. The individual flowers are tiny (.13") and produce clusters of tiny, three-sided, black seeds enclosed in papery winged husks.

Japanese knotweed and Himalayan knotweed

Animal type	Goats.	Cattle.
Animal class	Does and kids; yearlings.	NI.
Growth stage for treatment	Vegetative and flowering stages.	
Palatability	Goats are somewhat reluctant to graze it at first, but then become more accustomed to it.	Cattle readily graze knotweed.
Effectiveness of grazing treatment	NI.	
Plant response	Grazing reduces the number of buds and slows the growth process significantly.	
Grazing objective	Objective is to graze at a heavy to severe utilization level during the vegetative and flowering stages.	
Number of treatments per year	Multiple grazing treatments are often necessary.	
Number of treatment years	At least 3 years of grazing treatment are necessary.	
Practicality of method	Grazing is somewhat practical, but depends on the time of year and how much labor is required.	
Recommendation as a control method	The survey respondent strongly recommends this treatment for control of Japanese knotweed.	
Potential integration with other control methods	Biological control and hand crews can be integrated with grazing.	
Source of information	Survey (1).	
Comments	The survey respondent noted that cattle would graze the plant more so than goats.	
Summary	Only one survey response and no literature concerning Japanese knotweed control. The survey respondent recommended heavy to severe utilization during the vegetative and flowering stages.	

Kochia

(*Kochia scoparia*)



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Description:

Kochia is a summer annual plant common on disturbed areas that grows up to 6 feet tall and 4 feet wide. The seedlings appear in late spring and the first leaves are narrow, dull green in color, and covered in fine hair. The hairs are especially noticeable along the leaf edges. Kochia produces a single stem that branches above the base. The slender stem often has a reddish tint in late spring, is round, and normally covered with fine hair. The leaves grow in an alternate pattern along the stem. They have 3 to 5 prominent veins, are linear to lance shaped, and can grow to 2 inches in length. They have no stem, smooth edges, and hairs growing from the edges. The tops of the leaves are normally smooth, while the bottoms are covered in fine hairs. The flowers are tiny and inconspicuous. They grow in dense clusters from where the leaves meet the upper stems. The flower heads produce prominent, modified leaves that are long, narrow, and pointed. This gives the flower heads a prickly appearance. The tiny seeds are a dull brown color, wedge shaped, and numerous.

Kochia

Animal type	Sheep.	Goats.	Cattle.
Animal class	All classes.		
Growth stage for treatment	All stages up to flowering.		
Palatability	Palatability is excellent when plants are young, but it declines as plants mature.		
Effectiveness of grazing treatment	Effective if the plant is heavily grazed early in growing season.		
Plant response	Heavy, repeated grazing will reduce plant numbers, size, and seed production.		
Grazing objective	Objective is to prevent the plant from producing seed, while avoiding possible toxicity to livestock.		
Number of treatments per year	A minimum of 2 grazing treatments per year or continuous grazing to prevent flowering.		
Number of treatment years	Several years are probably necessary due to soil seed bank.		
Practicality of method	Grazing can be very practical if other forage is available to reduce toxicity or if grazing period is shorter than 60 days.		
Recommendation as a control method	Livestock are recommended as a control method for this weed.		
Potential integration with other control methods	Grazing is compatible with all other methods.		
Source of information	Literature (5).		
Comments	There were no survey responses. The literature strongly supports grazing but with caution to avoid toxic levels of several compounds.		
Summary	Kochia is a summer annual plant and considered to be a good quality forage. The plant contains oxalates, alkaloids, saponins, nitrate, and sulfate, which may cause toxicity to grazing animals. Avoid grazing for more than 60 days and supplement with other forages or dicalcium phosphate.		

Leafy spurge

(*Euphorbia esula*)



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Description:

Leafy spurge is a long-lived perennial plant that can grow up to 3 feet tall. The leaves are long and narrow, growing up to 4 inches in length. The leaf edges are smooth, hairless, and get wider near the tips. They grow in an alternate pattern along numerous smooth stems that produce many branches near the top of each stem. The stems and leaves are filled with white sap that immediately begins to ooze from any broken part. The tiny flowers are a bright yellow-green color and grow above 2 or 3 heart-shaped, leaf-like structures of the same color. The fruit is composed of a capsule divided into three compartments. Each compartment contains numerous small, smooth, grey-to-brown colored seeds. The root system spreads horizontally and vertically, often growing to depths of more than 30 feet. The brown roots produce many pink-colored buds which can produce new plants. The entire plant turns a bright red color in the fall. Leafy spurge is readily eaten by sheep and goats after being slowly introduced to the diet.

Leafy spurge

Animal type	Sheep.	Goats.
Animal class	All classes.	
Growth stage for treatment	Vegetative stage.	Vegetative to flowering stages.
Palatability	Sheep must learn to eat leafy spurge. They prefer young plants.	Goats readily eat leafy spurge at all growth stages.
Effectiveness of grazing treatment	Effectiveness is low the first year but improves after the second year. Stem density and biomass significantly declines after several years of grazing.	
Plant response	Plants may increase in the second treatment year. Plant biomass and stem density may decline beginning the third year of treatment. If grazing is discontinued, leafy spurge can return to its original density.	
Grazing objective	Objective is to remove 95 percent of top growth and graze re-growth to prevent flowering and seed production.	
Number of treatments per year	For a leafy spurge monoculture, use continuous grazing throughout growing season. When desirable species are present, use rotational grazing and graze leafy spurge at least twice per season.	
Number of treatment years	Grazing treatment should be continued for at least 4 to 5 years.	
Practicality of method	Survey respondents reported grazing to be practical if adequate control and management of livestock is achieved.	
Recommendation as a control method	Sheep and goats are highly recommended as a control method for leafy spurge when combined with other methods. Also recommended when used alone.	
Potential integration with other control methods	Very high potential for integrating grazing with flea beetles and fall herbicide spraying.	
Source of information	Surveys (14); Literature (17).	
Comments	Literature and survey results strongly agree.	
Summary	Sheep and goats are very effective at reducing biomass on an annual basis when leafy spurge is grazed to a moderate to severe level of utilization during the vegetative to flowering stages of growth. Stem density reductions will occur after 4 or more consecutive years of grazing treatments. This treatment is most effective when combined with other control methods such as herbicides and biological control.	

Medusahead

(Taeniatherum caput-medusae)



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Description:

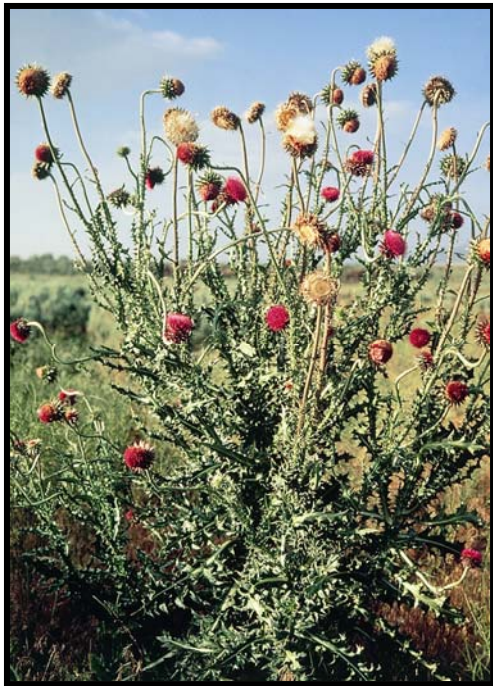
Medusahead is a winter annual grass that normally grows from 6 to 10 inches tall. However, it can grow to 24 inches tall when rainfall and temperatures are ideal. Medusahead prefers to grow in clay soil. It begins growing in the fall and produces narrow, rolled leaves that give the individual plants a slender appearance. The stems grow mostly upright from the base of the plant and produce a seed head that is dense, shaped like a spike, and bristly in appearance. The seed heads appear in late May to June after other annual grasses. They are almost as long as they are wide. The seed heads produce long (1-4"), thin bristles or awns that grow parallel to the head when green but become twisted and spread out from the head when mature. The seed head does not easily break apart when mature because individual seeds fall out leaving the long, thin bristles attached to the seed head. The plant turns from a wheat color to a very light cream color after the seeds disperse. The plant normally contains large amounts of silica, allowing the dead plants to decompose more slowly than other annual grasses and form a dense thatch.

Medusahead

Animal type	Sheep.	Goats.	Cattle.
Animal class	Ewes and wethers.	Does and wethers.	Cows and calves.
Growth stage for treatment	Seedling to vegetative stages.		Seedling stage.
Palatability	Moderate palatability before flowering. Palatability drops rapidly as plants flower and mature.		Moderate palatability when plants are vegetative.
Effectiveness of grazing treatment	Very effective if grazed repeatedly and seed production is prevented. Higher stock density produces better results		
Plant response	Reduced plant vigor and population size after 2 years of grazing treatment.		
Grazing objective	Graze early in the season to prevent seed production and reduce medusahead mulch.		
Number of treatments per year	One treatment per year on newly emerged plants.		
Number of treatment years	Two years of treatment are recommended to reduce populations.		
Practicality of method	Grazing is practical with intensive management and adequate control of livestock.		
Recommendation as a control method	Livestock can be effective if they are allowed to graze as soon as enough plant material is available to sustain grazing and heavy utilization levels are achieved. Best following a burning treatment to remove old seed heads.		
Potential integration with other control methods	Grazing can be used with burning, mechanical methods, and herbicides.		
Source of information	Surveys (1); Literature (6).		
Comments	General agreement between survey response and literature results.		
Summary	Livestock will eat medusahead when it is in the vegetative stage and significant reductions in plant populations are possible with 2 years, of heavy grazing at high stock density. Livestock use of the plant declines rapidly as the plant matures.		

Musk thistle

(*Carduus nutans*)



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Description:

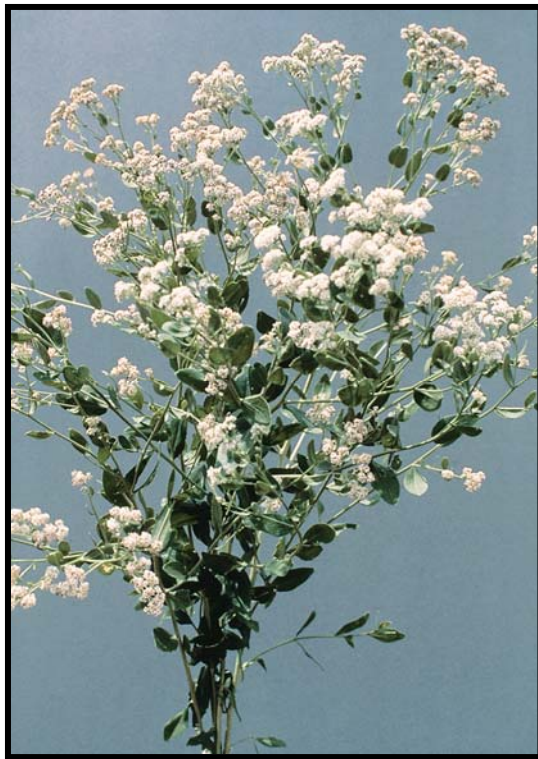
Musk thistle is a biennial or occasionally a winter annual growing up to 6 feet in height with a large, fleshy taproot. It begins growth by producing a low-growing circle of dark green, glossy leaves with wavy, deeply cut margins and a light yellow rib running the length of each leaf. The leaf edges also have many light-colored, sharp spines. The leaves are long and wide, and they can grow to more than 10 inches in length the first year. During the spring of the second year, several thick stems grow, producing smaller, very spiny leaves that grow alternately around the stem. Additional spiny plant tissue grows from the stem, giving the stem a winged appearance. Each stem produces a large flower (1.0-2.5" in diameter) that is normally a rose-purple color but can be white. The flowers are globe shaped and sit on top of densely grouped, spin-tipped modified leaves. A useful identification characteristic is that the flower heads normally droop, giving the plant the other common name of nodding thistle. The seeds are small, straw colored, and have a plume growing from the end.

Musk thistle

Animal type	Sheep.	Goats.	Cattle.
Animal class	All classes.		Cows and calves.
Growth stage for treatment	Rosette to bolting stages.		
Palatability	Sheep and goats will readily graze musk thistle.		Cattle will graze musk thistle until the late bud stage.
Effectiveness of grazing treatment	Repeated grazing is necessary to be effective in reducing plant biomass and plant density.		
Plant response	Grazing can reduce plant vigor, size, and flower production.		
Grazing objective	Graze this weed heavily during the bolting stage. Remove livestock for approximately 2 weeks and graze again to prevent flowering.		
Number of treatments per year	Grazing only once may be adequate if plant is grazed in the bud/flowering stage.		Grazing may need to occur twice if plants re-grow.
Number of treatment years	A minimum of 3 years is needed to reduce populations.		
Practicality of method	Survey respondents reported grazing to be practical if adequate control and management of livestock is achieved.		
Recommendation as a control method	Livestock are recommended as a control method when multi-year grazing treatments are possible.		
Potential integration with other control methods	Grazing can be effective when used in combination with herbicide application.		
Source of information	Survey (1); Literature (4).		
Comments	General agreement between survey results and literature.		
Summary	Goats, sheep, and cattle can prevent flowering of musk thistle with repeated grazing. Goats are the preferred grazing animal, followed by sheep and then cattle. Sheep and cattle prefer to graze this plant when it is young and spiny flower heads have not developed. Grazing works best when combined with herbicide treatment.		

Perennial pepperweed

(Lepidium latifolium)



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Description:

Perennial pepperweed is a hardy, perennial plant that normally grows to about 3 feet but can exceed 6 feet tall when conditions are ideal. It reproduces from seeds and an extensive, deep, creeping root system. Seedling plants and leaves growing from existing plants have long stalks, grow up to 12 inches in length, and are much longer than wide with pointed tips. The leaf edges range from smooth to ragged. Stem leaves are shaped the same but are much smaller and grow on a short stalk. Both types have a prominent white vein running up the middle of each leaf. The tiny white flowers grow in numerous, rounded clusters on the ends of the branches. The individual flowers have four petals and are less than 0.2 inches across. The seeds are produced in a flat, elongated capsule that has two sides.

Perennial pepperweed

Animal type	Sheep.	Goats.	Cattle.
Animal class	Wethers, ewes, does, kids, and yearlings.		Cows.
Growth stage for treatment	Seedling through flowering stage.		Seedling through early vegetative stage.
Palatability	Sheep readily consume plants until early flowering stage.	Goats readily consume plants until mature, then selected new leaves.	Cattle readily consume plants until late vegetative stage.
Effectiveness of grazing treatment	Animals will remove a large percentage of biomass each time they graze, but the plant will quickly return once grazing is discontinued.		
Plant response	Some indication that plant density and vigor will decline with repeated grazing, but massive root systems allow the plant to quickly recover once grazing pressure is removed.		
Grazing objective	Graze to remove majority of above-ground plant biomass with each grazing treatment, and repeat when adequate re-growth is available.		
Number of treatments per year	Grazing treatment should be conducted at least 3 times each year.		
Number of treatment years	Grazing must continue for a number of years due to the plant's extensive root system, which provides for re-growth in subsequent years.		
Practicality of method	Animals will readily eat immature perennial pepperweed, but the grazing treatment will need to continue for many years.		
Recommendation as a control method	Livestock are best used to graze solid stands of perennial pepperweed early in the growing season. Old, standing plant material should be removed to facilitate grazing.		
Potential integration with other control methods	Grazing can be used with all other control methods.		
Source of information	Surveys (5); Literature (7).		
Comments	General agreement between survey and literature results indicating animals will readily eat this weed in the early vegetative stage through early flowering. The results vary about the long-term effectiveness of the grazing treatments.		
Summary	Perennial pepperweed is readily grazed by sheep, goats, and cattle when it is in the seedling to early flowering stage. Repeated, intense grazing can significantly reduce biomass and density in the year the grazing occurs but grazing must be continued indefinitely. Grazing should occur prior to seed set since germination of viable seeds is improved by the rumination process.		

Poison hemlock

(*Conium maculatum*)



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Description:

Poison hemlock is a very poisonous biennial plant that grows to 10 feet tall from a large, stout, white taproot. The leaves are shiny, bright green, and lacy and can be mistaken for a fern leaf or the wild carrot plant. The leaves grow on stalks that clasp the plant stem. The leaves have a disagreeable odor described as “musty” or “mousy” when crushed. The stems grow upright and are large, hollow, and covered with purple spots or mottles. The stems are multi-branched and produce umbrella-shaped clusters of numerous, small, white flowers. The flower clusters grow to approximately 3 inches across, are flat topped, and appear in early summer.

Poison hemlock

Animal type	Sheep.	Goats.	Cattle.
Animal class	None.		
Growth stage for treatment	Poisonous at all stages of growth.		
Palatability	Poisonous.		
Effectiveness of grazing treatment	Not recommended.		
Plant response	Not recommended.		
Grazing objective	Not recommended.		
Number of treatments per year	Not recommended.		
Number of treatment years	Not recommended.		
Practicality of method	Not recommended.		
Recommendation as a control method	Not recommended.		
Potential integration with other control methods	Not recommended.		
Source of information	Survey (1); Literature (5).		
Comments	According to the literature, poison hemlock is one of the most toxic plants in the Western United States, yet one survey respondent claims goats will consume the plant without harm.		
Summary	Although one survey respondent and some popular press articles indicate that goats can eat poison hemlock without danger, the literature overwhelmingly considers this plant toxic to all classes and types of animals. The damage ranges from birth defects to rapid death. Grazing of this plant is not recommended.		

Purple loosestrife

(*Lythrum salicaria*)



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Description:

Purple loosestrife is a tall (6 to 8 feet) perennial plant growing from spreading underground stems. It reproduces primarily by seed. It grows almost exclusively in wet areas such as marshes, stream banks, rivers, and the edges of lakes. The leaves are pointed, are four times as long as they are wide, have smooth edges, and grow opposite each other or in whorls on the stems. The stems are generally square, can be hairy or smooth, and are branched. The flowers are a striking rose-purple color and appear on spikes that can be up to 3 feet long. The flowers have 5 to 7 petals growing from a green, tube-like structure. The tiny seeds are produced in a 2-celled pod.

Purple loosestrife

Animal type	Cattle.
Animal class	Cows.
Growth stage for treatment	Vegetative to flowering stages.
Palatability	Purple loosestrife is low in palatability.
Effectiveness of grazing treatment	Purple loosestrife canopy cover was reduced by 40% in a New Jersey experiment.
Plant response	NI.
Grazing objective	Reduce purple loosestrife canopy cover to allow desirable plants to grow.
Number of treatments per year	Continuous throughout growing season
Number of treatment years	NI.
Practicality of method	Grazing by cows on small acreage was considered practical.
Recommendation as a control method	Grazing is usually not recommended as a control treatment for this weed.
Potential integration with other control methods	NI.
Source of information	Literature (1).
Comments	One small study is reported in the literature with no supporting information.
Summary	There is very little information available concerning grazing as a control method for purple loosestrife. One source in the literature indicated that continuous, light cattle grazing reduced canopy cover of this plant by 40 percent. Most references do not recommend grazing as a tool due to potential damage to stream banks and spreading of the seed.

Purple starthistle

(*Centaurea calcitrapa*)



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Description:

Purple starthistle is an annual or biennial plant that can grow to more than 6 feet tall. The seedling and older leaves grow in a circular pattern low to the ground, with straw-colored spines in the center. They are deeply divided into long, narrow sections, except for the tip, which is undivided, narrow, and pointed. The leaves are normally covered in fine hairs that resemble cobwebs and have a prominent light-colored rib running the length of the leaf. The divisions in the stem leaves and hairiness become less obvious as they grow up the stem and mature. The flowers are normally purple to pinkish in color and are produced on numerous branches growing from the stems. The flowers sit on top of a collection of modified leaves that are yellowish-green in color and tipped with straw-colored spines that are often more than an inch long. The seeds are light tan in color and have a plume of short bristles growing from one end.

Purple starthistle

Animal type	Goats.
Animal class	Does and kids.
Growth stage for treatment	All growth stages.
Palatability	Goats do not readily graze purple starthistle.
Effectiveness of grazing treatment	Grazing is somewhat effective. It will not prevent seed production if grazed too late.
Plant response	Plants experience reduced growth during the treatment year. Rosettes re-grow after grazing animals are removed.
Grazing objective	Grazing should be timed to prevent seed production.
Number of treatments per year	One grazing treatment per year can be sufficient if grazed at the flowering stage.
Number of treatment years	Grazing treatment should be conducted for 3 or more years to reduce plant populations.
Practicality of method	Grazing is not considered to be a very practical control method.
Recommendation as a control method	Grazing by itself is not recommended as a primary control method.
Potential integration with other control methods	Grazing can be effectively combined with herbicide treatments.
Source of information	Literature (2).
Comments	Purple starthistle is less palatable than yellow starthistle. Goats will not graze it when other forage is available.
Summary	Confine goats onto purple starthistle and force them to eat it. Repeated grazing is usually not practical. It is best to treat regrowth with herbicides.

Quackgrass

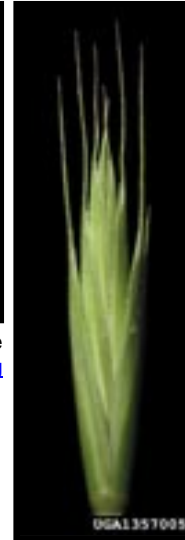
(*Elytrigia repens*)



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Description:

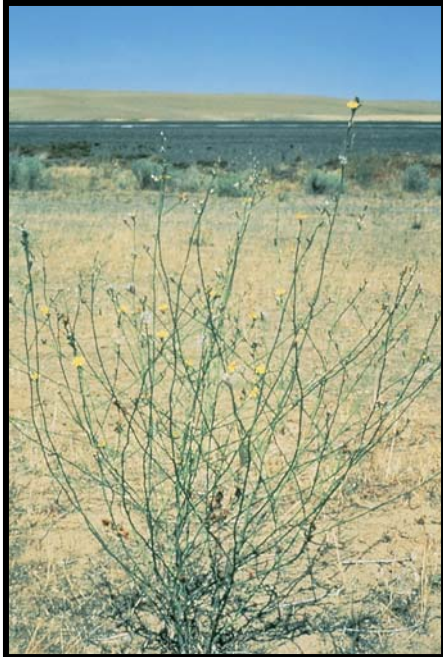
Quackgrass is a large, coarse, cool-season, perennial grass that can grow to 4 feet tall. It spreads by seeds and long, slender, underground stems. It often grows in thick patches. The seedling leaf is long and wide and may be hairy or smooth on the upper surface, but it is normally smooth on the lower. Later leaves are rolled when in the bud and grow to 12 inches long and .5 inch wide. They are dull green to blue-green in color and clasp the stem with narrow claw-like bases. They often have a constriction near the leaf tips. The stems are round, upright, hollow, and smooth, except that sparse hairs may be present near the base of the stem. The seeds of quackgrass grow in two rows along the sides of the seed head. The seed head is a long, narrow spike that can grow to 8 inches in length and appears flattened in cross section. Individual seeds have short, pointed tips known as awns. The underground stems are white and ringed with root hairs approximately every inch along the length.

Quackgrass

Animal type	Horse.	Sheep.	Cattle.	Goats.
Animal class	All classes.			
Growth stage for treatment	Early vegetative stage.			
Palatability	Readily grazed by all animals.			
Effectiveness of grazing treatment	Grazing is somewhat effective as a control method.			
Plant response	Repeated, heavy grazing reduces plant vigor.			
Grazing objective	Grazing should occur at a severe utilization level during the growing season to prevent seed production and prevent growth.			
Number of treatments per year	Graze continuously until other control methods are applied.			
Number of treatment years	NI.			
Practicality of method	Grazing is considered somewhat practical.			
Recommendation as a control method	Grazing is recommended as a control method in the literature.			
Potential integration with other control methods	Grazing will probably not be effective alone. It can be used in conjunction with other methods such as tillage or herbicides.			
Source of information	Literature (4).			
Comments	No survey respondents reported using livestock to control this weed.			
Summary	Quackgrass is a relatively palatable grass that will be eaten by most grazing animals. Early, severe grazing will reduce plant vigor and prevent seed production.			

Rush skeletonweed

(*Chondrilla juncea*)



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Description:

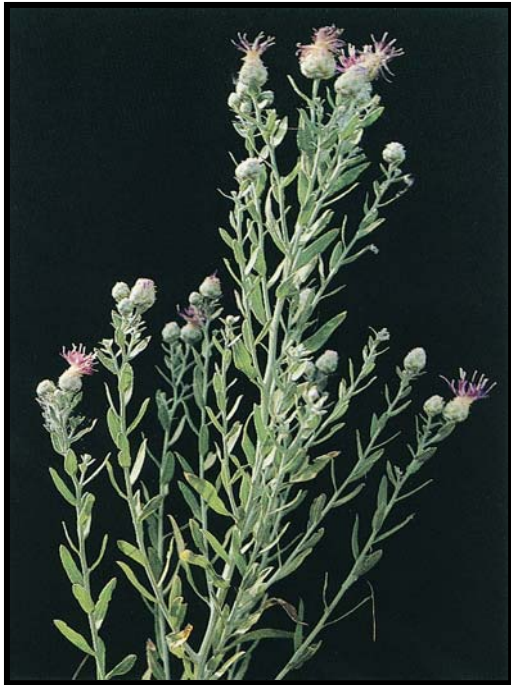
Rush skeletonweed is a perennial plant that grows to 4 feet tall. The plant reproduces by seed and from a stout, creeping root system. The seedling leaves form a circular pattern. The leaves resemble those of a dandelion with deep, backward-facing lobes that are of similar size. The basal leaves wither and die as the stems develop. The stems are nearly leafless, with the lower 4 to 6 inches covered with obvious red-colored, downward-pointing hairs. The upper stems are hairless. The stems and branches ooze a white, milky sap when cut. The flower heads are produced in a scattered fashion among the upper branches. They are bright yellow in color and about 0.75 inches in diameter. They have numerous (up to 15) strap-shaped petals with flat tips that are notched. The small seeds range from a light to dark brown color, are covered with prominent ribs, and have numerous white bristles growing from one end.

Rush skeletonweed

Animal type	Horse.	Sheep.	Cattle.
Animal class	NI.		
Growth stage for treatment	Vegetative stage.	Rosette to flowering stage.	Vegetative to flowering stage.
Palatability	Rush skeleton weed is readily grazed by horses.	Rush skeletonweed is readily grazed by sheep.	NI.
Effectiveness of grazing treatment	Grazing is somewhat effective for about a year.	NI.	Grazing is somewhat effective.
Plant response	Plants are damaged for about a year.	Plants display reduced densities and seed production.	NI.
Grazing objective	Grazing should result in heavy utilization of top growth.	Grazing intensity should be moderate and continuous during the growing season.	Grazing should result in severe utilization during the growing season.
Number of treatments per year	Use 1 continuous treatment for controlling this weed. Prevent damage to desirable plants.		
Number of treatment years	NI.		
Practicality of method	Horse grazing is considered to be very practical.	Sheep grazing is considered somewhat practical.	Cattle grazing is considered somewhat practical.
Potential integration with other control methods	NI.	Use biological control and competitive vegetation to improve effectiveness.	Grazing is compatible with all other control methods.
Recommendation as a control method	Grazing with horses is strongly recommended.	Grazing with sheep is somewhat strongly recommended.	Grazing with cows is somewhat strongly recommended.
Source of information	Surveys (2); Literature (3).		
Comments	General agreement that grazing can damage rush skeletonweed.		
SUMMARY	Horses readily graze rush skeletonweed during the vegetative stage and maintain their body condition. Severe utilization by cattle of rush skeletonweed was thought by one survey respondent to be somewhat effective and strongly recommended it as a control method, particularly where herbicide use is cost prohibitive. The literature indicated that continuous, moderate sheep grazing was effective.		

Russian knapweed

(Acroptilon repens)



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Description:

Russian knapweed is a long-lived, perennial plant that grows up to 3 feet tall. It reproduces by seeds and from dark, underground stems and roots. Vegetative reproduction often results in the formation of very dense stands of Russian knapweed that can eliminate all other plant species. The seedling and new plant leaves grow in a circular pattern, are blue-green in color, and are covered with fine hairs that give the appearance of a fine, white powder. The first leaves have an elliptical shape and smooth edges. Leaves that are produced later develop wavy margins with pronounced lobes. The upright stems are covered with fine grey hairs and produce numerous branches. The stem leaves grow in an alternate pattern, with the lower leaves being narrow and up to 4 inches long with deeply lobed edges. The upper leaves have smooth to slightly toothed edges and normally grow to about an inch in length. Both can be covered with short, matted hairs or hairless. The flowers are normally pink to purple in color and sit on top of a cone-shaped collection of tan-colored, modified leaves that have papery margins. They grow from .25 to .5 inches across, and each branch produces one flower. The seeds are brown to grey in color and tipped with light-colored hairs that drop off when the seed is ripe.

Russian knapweed

Animal type	Sheep.	Goats.
Animal class	Dry ewes.	All classes.
Growth stage for treatment	Early vegetative stage.	Vegetative to flowering stages.
Palatability	Sheep will reluctantly consume Russian knapweed.	Goats consume all stages but prefer young, pre-bloom plants.
Effectiveness of grazing treatment	Repeated sheep and goat grazing reduces plant biomass and vigor.	
Plant response	Russian knapweed will re-grow within one growing season after grazing stops.	
Grazing objective	Graze 80 percent or more of the plant, but do not exceed 50 percent utilization of desirable species.	
Number of treatments per year	Graze 3 times per season. Allow Russian knapweed to re-grow 8-10 inches between treatments but do not allow flowering to occur.	
Number of treatment years	The treatment should be for consecutive, multiple years.	
Practicality of method	Most survey respondents rated grazing as very practical.	
Recommendation as a control method	Survey respondents recommend sheep and goat grazing. The literature review was not supportive of grazing as a control method.	
Potential integration with other control methods	Grazing can be combined with herbicide treatments.	
Source of information	Surveys (5); Literature (6).	
Comments	Literature and survey responses were in conflict concerning the palatability of Russian knapweed to sheep and goats.	
Summary	<p>Most of the literature indicates that livestock will not eat Russian knapweed. However, survey respondents indicated that under certain conditions, sheep and goats will graze Russian knapweed, especially when plants are young and animals are experienced. To be effective, grazing must be repeated multiple times each season and multiple years. This grazing treatment will result in reduced biomass and density of Russian knapweed, but population will return to pre-grazing density upon cessation of grazing treatments if other control methods are not applied.</p>	

Scotch broom

(Cytisus scoparius)



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Description:

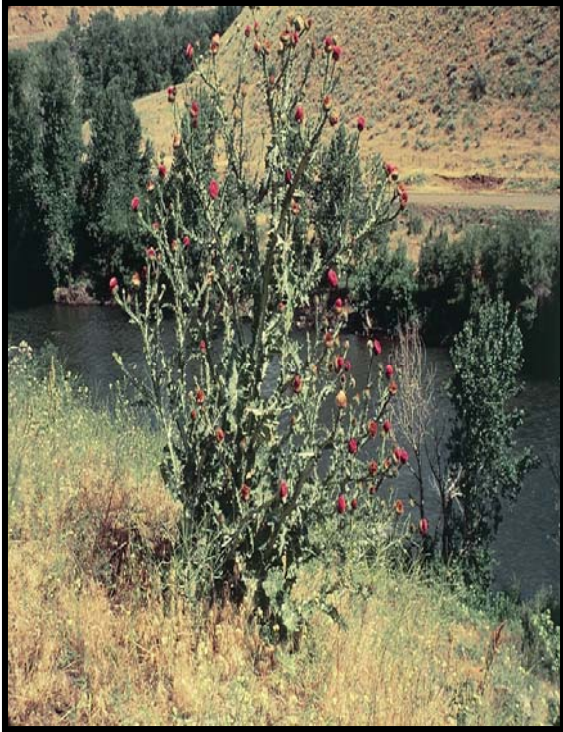
Scotch broom is a perennial shrub that grows to 10 feet in height. A large number of slim branches grow upright from the base of the plant. The cross-section view of most stems will resemble a star when cut. New twigs are covered with wavy hair that falls off as the stem matures. The stems are commonly almost bare of leaves. The leaves normally grow in groups of threes and in an alternate pattern on the stem. They are small and inconspicuous. The flowers are about 1 inch long, pea shaped, and grow from where the leaves meet the stems. They are bright yellow in color and can completely cover the stems of this plant. After flowering, the plant produces abundant, flat pods that are green, brown, or black in color. The pods have a fringe of white hair around the edges. The plant grows from deep spreading tap roots, but it reproduces from seeds produced in the pods.

Scotch broom

Animal type	Sheep.	Goats.
Animal class	Ewes and wethers.	Does and wethers.
Growth stage for treatment	All growth stages but prior to flowering most effective.	
Palatability	Goats readily browse Scotch broom. Sheep will browse young shoots and small plants. Scotch broom is mildly toxic and may affect palatability.	
Effectiveness of grazing treatment	Sheep and goat grazing is most effective when Scotch broom infestation is of low density.	
Plant response	There is reduced plant vigor. Small plants can be killed by browsing and stripping of the bark.	
Grazing objective	Grazing should prevent plant growth and seed production.	
Number of treatments per year	Grazing should be continuous or as needed to prevent plants from flowering.	
Number of treatment years	Treatment should continue for more than 5 years as most of the seeds in the soil will germinate within that period.	
Practicality of method	Grazing by goats is practical because they will browse continuously. Sheep will select other forage if available.	
Recommendation as a control method	Grazing may be more effective when combined with other methods such as mowing, chemical applications, or burning.	
Potential integration with other control methods	Grazing sprouts, following burning or mechanical control, is the recommended technique, but be aware of possible toxic reactions.	
Source of information	Literature (5).	
Comments	Goats are more effective than sheep for controlling Scotch broom.	
Summary	Much of the literature indicates that goats will readily eat Scotch broom foliage and strip the bark. The best reduction of Scotch broom occurs when plant density is low and plants are young. Older, larger plants are much more resistant to grazing.	

Scotch thistle

(*Onopordum acanthium*)



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Description:

Scotch thistle is a large, biennial plant that can grow to 12 feet tall but is usually 4 to 8 feet tall. It only grows from seeds. During the first year, the seedling leaves can grow to 2 feet in length and 1 foot wide. They are very wavy in appearance, tipped with sharp spines, and densely covered with fine, white hairs, giving the plant a blue-grey color. A thick, upright stem is produced the second year. The stem has “wings” of spiny, leaf-like projections growing along its length. The stem leaves grow in an alternate pattern, have deep lobes, and are spine tipped. The entire plant is covered with fine, dense hairs, giving it a woolly appearance. Two to three flower heads are produced on each branch. They are normally a bright reddish-purple color and 1 to 2 inches across. They sit on a globe-shaped collection of small, modified leaves that are yellowish-green in color and have a sharp spine on each tip. The seeds are shaped like a spatula, are smooth, and have a plume of hairs growing from one end.

Scotch thistle

Animal type	Sheep.	Goats.	Cattle.
Animal class	Ewes and lambs.	Does, yearlings and kids.	Cows and calves;.
Growth stage for treatment	Seedling (rosette) to vegetative stages.		
Palatability	Palatability ranges from some reluctance to readily consumed. It may take time for grazing animals to become familiar with the plant.		
Effectiveness of grazing treatment	Sheep and goat grazing are considered somewhat effective for about a year. Cattle and goat grazing are considered very effective for more than a year. Cattle use requires high stock density.		
Plant response	Sheep and goat grazing reduces the buds and slows the growth process significantly. Cattle and goats reduce abundance by 30-50 percent.		
Grazing objective	Graze sheep and/or goats to achieve heavy to severe utilization. Graze cattle and goats at a severe level using short-duration, high-intensity grazing practices.		
Number of treatments per year	NI.		
Number of treatment years	Treatment should be for consecutive, multiple years.		
Practicality of method	Grazing is considered somewhat to very practical as a control method.		
Recommendation as a control method	Survey respondents somewhat to strongly recommended livestock grazing as a control method.		
Potential integration with other control methods	Grazing is very effective when followed by an herbicide treatment.		
Source of information	Surveys (4); Literature (2).		
Comments	Make sure grazing practices do not harm desirable vegetation. Healthy perennial grasses are a long-term control for Scotch thistle. There is not much reported in the literature. May need to use electric fencing to confine animals in the infested areas.		
Summary	Heavy grazing of Scotch thistle during the rosette to vegetative stage is considered effective, at least in the short term. Maintaining a healthy perennial grass population is essential to long-term control.		

Spanish broom

(*Spartium junceum*)



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Description:

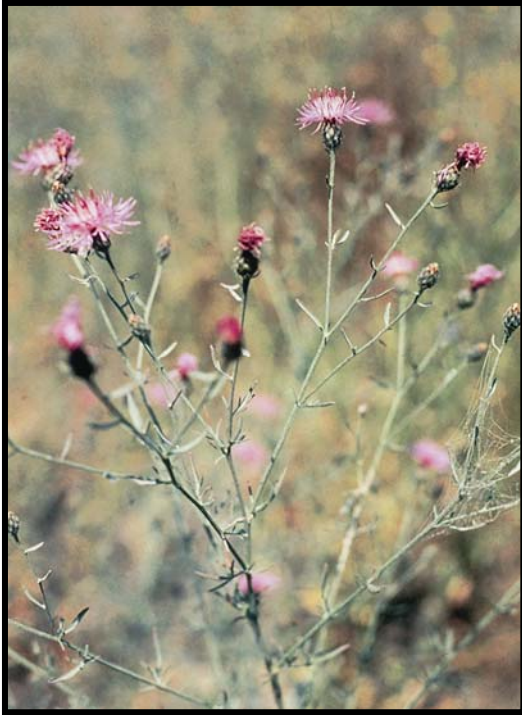
Spanish broom is a perennial shrub that grows from 6 to 10 feet tall with stems that grow in an upright pattern. The stems are bright green when young and turn brown as the plant ages. They are hairless, round in cross section, and have fine ribs on the surface. The stems are almost leafless and branch at the top. The leaves that do appear grow in an alternate pattern and are about .5 inch long with smooth edges. They are long and narrow in shape and bright green, with a smooth upper surface and a hairy lower surface. The flowers grow in thick clusters near the ends of the branches on stalks that can reach nearly 2 feet long. They are bright yellow, fragrant, about 1 inch long, and shaped like flowers produced by pea plants. The plant produces seed pods that are filled with 10 to 15 seeds. The 3-inch pods are brown, flat, and hairy. They twist and split as they dry, spilling the seeds on the ground.

Spanish broom

Animal type	Goats.
Animal class	All classes.
Growth stage for treatment	Seedling and young plant (< 1 year old) stages.
Palatability	Spanish broom is mildly toxic and considered low in palatability.
Effectiveness of grazing treatment	Effectiveness is unknown. Repeated grazing may be effective in reducing newly established stands.
Plant response	NI.
Grazing objective	Grazing should prevent plant growth and seed production.
Number of treatments per year	Grazing should be continuous or as needed to prevent plants from flowering.
Number of treatment years	Treatments should last for more than 5 years.
Practicality of method	Grazing may be useful when combined with other methods, such as mechanical or burning.
Recommendation as a control method	Recommendations for use of grazing are weak, but goats are being used in some areas.
Potential integration with other control methods	Grazing sprouts and young plants following burning or mechanical control is the recommended technique, but be aware of possible toxic reactions.
Source of information	Literature (2).
Comments	The literature weakly supports the use of goats as a tool to manage Spanish broom, but no empirical evidence was found to support the use of livestock as an effective tool to reduce plant populations.
Summary	Very little empirical information is available. Most literature indicates goats will probably eat Spanish broom, although there is some indication that the plant may contain slightly toxic levels of alkaloids, glycosides, tannins, etc. Literature indicates that goats are best used to graze on new sprouts and/or young plants.

Spotted knapweed

(*Centaurea maculosa*)



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Linda Wilson, Univ. of ID
www.forestryimages.org

Description:

Spotted knapweed is a biennial or short-lived perennial plant that grows from 1 to 4 feet tall. It reproduces by seed and has a deep, thick taproot. New leaves are long and narrow, can grow up to 6 inches long, are deeply divided, and have smooth edges. The upper surface is rough. The stem leaves are small with finer divisions that become smaller as they reach the top of the stem. They grow in an alternate pattern, are narrow, and are covered with fine hair. Plants can produce from one to many stems — each with many branches and each producing a single flower head at its tip. The flowers are normally a light purple to pink color, up to 1 inch across, and sit on a cone-shaped collection of modified leaves. These modified leaves have comb-like edges with a black tip, which gives them a spotted appearance when viewed from a distance. The seeds are brown to grayish-brown and tipped with a group of light-colored hairs that drop when the seeds mature.

Spotted knapweed

Animal type	Sheep.	Goats.
Animal class	Ewes and lambs.	Does and kids.
Growth stage for treatment	All growth stages but before flowering is most effective.	
Palatability	Sheep and goats prefer young, small plants but will usually consume spotted knapweed at all growth stages	
Effectiveness of grazing treatment	Grazing is very effective if used to prevent seed production for at least several years. Effectiveness may be increased if combined with an herbicide treatment. Grazing must be tightly controlled to avoid damage to desirable species.	
Plant response	Grazing can reduce plant vigor, density, size, flower stems, and seed production.	
Grazing objective	Graze to prevent seed production for several years to reduce populations, while not impacting desirable plants.	
Number of treatments per year	Three grazing treatments per year, during rosette to bolting and then re-growth, is probably the preferred treatment. Grazing only once, heavily during the vegetative to flowering growth stages, may be effective as well	
Number of treatment years	A minimum of 3 years of treatment is recommended.	
Practicality of method	Most survey respondents considered sheep and/or goat grazing somewhat to very practical and recommend it as a control method.	
Recommendation as a control method	Graze this weed heavily during the bolting stage. Remove livestock for approximately two weeks and graze again to prevent seed head formation.	
Potential integration with other control methods	Grazing is most effective when combined with herbicide treatments. Spraying in the spring with 2,4-D prior to grazing and fall spraying after the grazing treatment have been used.	
Source of information	Surveys (9); Literature (13).	
Comments	The literature recommended two grazing treatments per year, while the survey respondents recommended one treatment during bud to flowering. Palatability may be reduced as the plant ages because of increased concentrations of cinicin. Sheep's digestive system may suffer if diet is comprised of more than 70 percent spotted knapweed. Spotted knapweed is considered moderately good forage. Sheep tend to strip leaves and leave the fibrous stems of mature plants.	
Summary	Spotted knapweed is readily grazed by sheep and/or goats. Control success depends on the prevention of seed production for at least three years. Two grazing schemes are popular: 1) twice grazing during rosette to bolting and then on re-growth and 2) once during bud to flowering stages. It may be necessary to manage grazing based on degree of utilization of desirable species. Using an herbicide treatment probably improves effectiveness.	

Tansy ragwort

(*Senecio jacobaea*)



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Description:

Tansy ragwort is normally a biennial or short-lived perennial plant that can grow up to 6 feet tall. It reproduces by seeds and from roots. The seedling leaves grow in a circular pattern, have ragged edges with deep lobes, and can grow up to 9 inches long. Leaflets grow opposite each other on stems radiating from the center of the plant. A single stem or many stems can grow from each plant during the second year. The stems are normally non-branched, except near the top, and can be hairy or smooth. The stem leaves grow in an alternate pattern, have numerous deep lobes, and grow from 2 to 8 inches long. Numerous, small flower heads are produced in dense clusters at the ends of the upper branches. The individual flowers are bright yellow with 10 to 15 petal-like flowers surrounding a button-like group of tiny disc flowers. Tansy ragwort has a short taproot that produces many spreading side roots.

Tansy ragwort

Animal type	Sheep.
Animal class	Ewes and lambs.
Growth stage for treatment	Vegetative to flowering (i.e., early summer) stages considered good forage. Rosette stage thought to be more effective in controlling the plant.
Palatability	Sheep readily eat tansy ragwort.
Effectiveness of grazing treatment	Literature indicates that sheep grazing is an effective control method.
Plant response	Sheep grazing defoliates the plant, reduces seed production, and reduces plant density.
Grazing objective	Prevent seed production and consume seedlings. Maintain a healthy perennial grass cover to suppress tansy ragwort seedling establishment.
Number of treatments per year	Multiple plant defoliations before flowering may promote a multiple stem, plant growth form. Continuous or rotational grazing is better than 1 short-duration, high-intensity grazing treatment.
Number of treatment years	Probably more than 2 years are necessary.
Practicality of method	May be practical if sheep will consume this weed or are taught to eat it and other forages are available.
Potential integration with other control methods	NI.
Source of information	Survey (1); Literature (5).
Comments	Tansy ragwort can comprise up to 50 percent of sheep's diets. Monitor sheep use; because toxins can accumulate over time. Not all sheep readily consume tansy ragwort. Lambs may need to learn to eat it. The one survey respondent indicated goat use of tansy ragwort, but provided no details. Multi-species grazing by sheep and cattle are effective in grass pastures infested with tansy ragwort because cattle will consume grass.
Summary	Most sheep readily graze tansy ragwort, and it is considered good sheep forage. Graze to prevent the production of seed over time and to consume seedlings. Maintain the health of perennial grasses to suppress ragwort establishment. Continuous or multiple rotational grazing is more effective than 1 short-duration, high-intensity grazing treatment.

Yellow starthistle

(*Centaurea solstitialis*)



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Description:

Yellow starthistle is a winter annual plant that can grow to 6 feet in height but is usually about 2 feet tall. The bright-green seedling leaves grow in a circular pattern and have deeply cut lobes with an arrowhead-shaped tip. They are 6 to 8 inches in length and 1 to 2 inches wide. The stem leaves are much smaller, grow in an alternate pattern, and have smooth edges and sharply pointed tips. The edges of the stem leaves extend down the stem, giving it a “winged” appearance. Several highly branched, stiff stems grow from the base and are covered in dense, white hairs, giving the plant a gray-green color and a matted appearance. Single, bright yellow flowers are produced on the ends of the branches. They sit on a cone-shaped group of modified leaves with numerous thin, straw-colored, .5- to 1-inch-long thorns growing straight out from the sides. The small seeds range from light to dark brown, and some have small bristles protruding from one end.

Yellow starthistle

Animal type	Sheep.	Goats.	Cattle.
Animal class	All classes		
Growth stage for treatment	All growth stages but before flowering is most effective.		Rosette to bolting stages.
Palatability	Sheep and goats will readily consume yellow starthistle.		Cattle will not consume the plant beyond bud stage.
Effectiveness of grazing treatment	Grazing can be effective if implemented often enough to prevent flowering for several years to reduce populations. Must tightly control grazing levels to avoid damage to desirable species.		
Plant response	Grazing reduces plant vigor, size, and flower production.		
Grazing objective	Graze heavily at least twice each year to prevent flowering and for enough years (3+) to reduce populations.		
Number of treatments per year	Two or three treatments are needed if grazing during the rosette or bolting stage. Grazing during after-flowering with goats may require only one treatment per year.		
Number of treatment years	Three to 5 years is likely needed to reduce populations and deplete the seed bank.		
Practicality of method	Grazing is considered very practical as a control method.		
Recommendation as a control method	Sheep and goat grazing is strongly recommended, but less so for cattle.		
Potential integration with other control methods	Grazing is most effective when combined with herbicide treatments.		
Source of information	Surveys (9); Literature (8).		
Comments	Goats are the most effective livestock to use for prescribed grazing.		
Summary	Yellow starthistle is readily grazed by sheep, goats, and cattle through the late bolting stage. Palatability is reduced as the plant ages, especially for cattle. This species is not as palatable as spotted knapweed. Control depends on the prevention of flower and seed production and must be applied at least twice per year over several (3+) years to be effective.		

Yellow toadflax

(*Linaria vulgaris*)



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Description:

Yellow toadflax, also called butter and eggs, is a perennial plant that grows up to 3 feet tall. It reproduces by an aggressive, spreading root system and seeds. The numerous leaves are a pale green color, very narrow, approximately 2.5 inches long, and pointed at both ends. They grow in an alternate pattern on the stems. The stems are smooth, grow upright, and are not usually branched. The flowers are similar in appearance to garden snapdragons. They are about 1 inch long and bright yellow with a bearded, orange throat. They also have a long, narrow spur growing from the bottom side of each flower. The flowers grow in long clusters at the tops of the stems. The seeds are produced in a round-shaped capsule that is approximately .25 inches across and has two chambers. The small seeds are flat and round with a rough surface. They have a notched, circular wing that has a papery texture.

Yellow toadflax

Animal type	Goats.
Animal class	Does and kids; wethers.
Growth stage for treatment	Not recommended.
Palatability	Goats are very reluctant to eat yellow toadflax.
Effectiveness of grazing treatment	Grazing is not very effective.
Plant response	Grazing has no effect on yellow toadflax.
Grazing objective	NI.
Number of treatments per year	NI.
Number of treatment years	NI.
Practicality of method	Grazing is not considered practical.
Recommendation as a control method	Grazing is not recommended as a control method for yellow toadflax.
Potential integration with other control methods	NI.
Source of information	Survey (1); Literature (4).
Comments	Yellow toadflax contains alkaloids and glucosides that may be toxic to grazing animals if eaten in large quantities. Literature indicates all animals are very reluctant to consume this plant.
Summary	Grazing with goats at a slight degree of utilization during flowering was not an effective treatment. Goats are reluctant to eat it at that stage. Does with kids declined or maintained body condition.

Appendix A
Noxious Weed Literature Review

Appendix A --Noxious Weed Literature Review

Canada thistle (*Cirsium arvense*)

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Appendix B
Survey Questionnaire

Appendix B -- Survey Questionnaire

Grazing Practitioner Version

Livestock Grazing Prescriptions for Noxious Weed Control

Hello Mr./Ms. _____,

You have been identified as someone who is knowledgeable in the use of livestock to control noxious weeds. My name is _____ and I'm with the University of Idaho. If you have the time, I would like to ask you some questions about your experience in using livestock to control weeds. It should take about 20 minutes. Information from this survey, along with information gathered from others, will be used to develop a handbook to help agencies and communities understand how livestock could be useful for weed management. This project is being conducted by the University of Idaho and University of Nevada. Please note: your answers will remain anonymous. Would you be willing to participate in the survey at this time?

If "no"... When would be a good time to call you back?

*Date: _____ Time: _____. Thank you, I'll call back then.
(Fill in date and time for call back)*

If "yes," continue with the script below...

Great! We'll begin with the survey. I have 27 questions concerning your experience in controlling noxious weeds with livestock. We will only discuss one livestock and weed species combination at a time. If you have used the same approach several times, please just summarize your experience. If, however, you have experience with more than one approach to controlling a weed with livestock or with more than one weed, we'll complete a separate questionnaire for each approach. Also, we want to know about both your "successes" and "failures."

Let's begin...

*Grazing Practitioner Version
Livestock Grazing Prescriptions for Noxious Weed Control*

1. *On what noxious weed have you used livestock grazing as a management tool?*

_____ (Weed ID:____)
(Enter common name of noxious weed.) (Weed identification symbol to be entered by the interviewer.)

2. *On how many different projects have you used livestock to control this weed?*
(Circle one.)

a. 1 project b. 2 projects c. 3 projects d. 4 projects e. more than 4 projects

3. *In what state(s) did you use livestock to control this weed?* (Circle all that apply.)

a. CA b. CO c. ID d. MT e. NV f. OR g. UT h. WA i. WY j. Other:____

4. *What species of livestock did you use?* (Circle one.)

a. cattle b. sheep c. goats d. Other: _____
(If other, enter species name.)

5. *What class of livestock was used?* (Circle one.)

If cattle: a. steers b. heifers c. cows d. cows & calves

If sheep: e. wethers f. ewes g. ewes & lambs h. ewe lambs

If goats: i. does j. wethers k. does & kids l. yearlings

If other: m. _____
(If other, enter class.)

6. *How was animal body condition affected?* (Circle one.)

a. improved b. stayed the same c. declined d. don't know

7. Did the weed cause side-effects or mechanical damage to your livestock? (Circle one.)

- a. no b. yes c. don't know

If "yes", what were the symptoms? _____
(Enter a description of the symptoms.)

8. During what season did your livestock graze this weed? (Circle all that apply.)

- a. spring b. summer c. fall d. winter

9. What was the growth stage of this weed when it was grazed? (Circle all that apply.)

- a. seedling b. vegetative c. flowering d. seed set
e. regrowth f. dormant g. don't know

10. Was this weed growing in a solid stand or were other forages available to your animals?

- a. solid stand b. other forages available

11. How heavily did your livestock graze this weed? (Circle one.)

- a. light (less than 40% removed) b. heavy (40-80% removed)
c. severe (more than 80% removed) d. don't know

12. How readily did your livestock eat this weed? (Circle one.)

- a. readily b. some reluctance c. very reluctant d. don't know

13. During which growth stage(s) will the livestock most readily eat this weed? (Circle all that apply.)

- a. seedling b. vegetative c. flowering d. seed
e. regrowth f. dormant g. don't know

14. *During which growth stage(s) is this weed least palatable to livestock? (Circle all that apply.)*
- a. seedling b. vegetative c. flowering d. seed set e. regrowth
f. dormant g. don't know
15. *Were you able to determine this weed's response to the grazing treatment? (Circle one.)*
- a. yes b. no (If yes, go to question 16. If no, go to question 22.)
16. *How long after the grazing treatment did you make your observations? (Circle one.)*
- a. immediately after grazing b. within a month c. within 1 to 6 months
d. within 6 months to one year e. more than a year f. don't know
17. *How effective was the grazing treatment in reducing the abundance of this weed? (Circle one.)*
- a. very effective b. somewhat effective c. not very effective d. don't know
18. *How long did the reduction in weed abundance last? (Circle one.)*
- a. less than one year b. one year c. more than one year d. don't know
19. *Did the grazing treatment damage this weed (size, color, number of flower heads, root mass, etc.)? (Circle one.)*
- a. yes b. no c. don't know
- If "yes," describe the damage:* _____
- _____
- (Enter a description of the damage.)
20. *How long did the plant damage last? (Circle one.)*
- a. less than one year b. about one year c. more than one year d. don't know

21. Was desirable vegetation damaged by the grazing treatment? (Circle one.)

a. yes b. no

If "yes," describe the damage: _____

(Enter a description of the damage.)

22. Were other weed control methods applied in conjunction with the grazing of your livestock? (Circle one.)

a. yes b. no

If "yes," describe the treatment: _____

(Enter a description of the method.)

23. How practical was this grazing treatment in controlling this weed? (Circle one.)

a. very practical b. somewhat practical c. not very d. not at all

24. How strongly would you recommend this treatment for controlling this weed? (Circle one.)

a. very strongly b. somewhat strongly c. not very d. not at all

25. What other information would you find helpful or recommend when using livestock to control this weed?

(Enter description.)

26. *Is managing livestock to control noxious weeds your primary occupation?*

a. *yes* b. *no*

If "no," what is your primary occupation? _____
(Enter occupation.)

27. *How long have you been involved in using livestock to control noxious weeds?*

(Enter length of time.)

This completes our survey. Thank you for taking the time to respond. Do you have any questions for me?

Appendix C
Grazing Prescription Form

Appendix C Grazing Prescription Form

Weed Name: _____

Animal type	
Animal class	
Growth stage for treatment	
Palatability	
Effectiveness of grazing treatment	
Plant response	
Grazing objective	
Number of treatments per year	
Number of treatment years	
Practicality of method	
Recommendation as a control method	
Potential integration with other control methods	
Source of information	
Comments	
Summary	

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