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Spring Creek Association

Weed Management Plan



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Table of Contents

Weed Management Plan Purpose.....3

Location and Land Status4

Severity of Noxious Weeds Within the Association Boundaries.....4

Plan of Work.....5

 A. Objectives and Goals5

 B. Prevention and Detection8

 C. Education and Awareness:9

 D. Land Stewardship10

 E. Revegetation and Rehabilitation.....10

 F. Land Disturbance Requirements (Soil Plan, Revegetation Plan & Security)11

 1. Soil Plan for Contractors or Ground Disturbance.....11

 2. Revegetation Plan:.....12

 G. Reclamation Standards12

 1. Site stability.....12

 2. Soil Management.....12

 3. Erosion Prevention.....12

 4. Revegetation.....12

 H. Weeds to Watch (Appendix C).....13

 I. Mapping and Inventory.....14

 J. Monitoring.....14

References.....15

Appendix A: Treatment and Revegetation Timeline.....16

Appendix B: Nevada Department of Agriculture Designated Noxious Weeds Lists.....14

Category "A" Weeds.....16

Category "B" Weeds.....	16
Category "C" Weeds.....	17
Appendix C: NRCS Web Soil Survey for Spring Creek, NV	18-22
Appendix D: Most Prominent SCA Noxious Weeds.....	22-58

The purpose of the Spring Creek Association Noxious Weed Management Plan is to strengthen, support, and coordinate private, county, state, and federal weed management efforts within Association boundaries, and promote implementation of ecologically-based integrated weed management programs. The plan is organized into five focal areas: Coordination, Prevention, Detection, Rapid Response and Monitoring/Maintenance.

Coordination

- Expand long term funding sources for private, county, state and federal land managers to implement a comprehensive weed management program that includes all aspects of integrated weed management.
- Utilize current prevention and Early Detection and Rapid Response (EDRR) strategies to reduce the introduction, establishment and spread of noxious weeds as well as support statewide noxious weed coordination.

Prevention

- Increase public education and awareness about environmental impacts and management of noxious weeds.
- Promote and support noxious weed research based on needs determined by land managers.

Detection

- Expand the use of EDDMapS West database system or other data collection software by landowners for noxious weed inventories on Association and private properties.
- Hire a private contractor to assess and inventory SCA common spaces and private properties on an as-needed basis.

Rapid Response

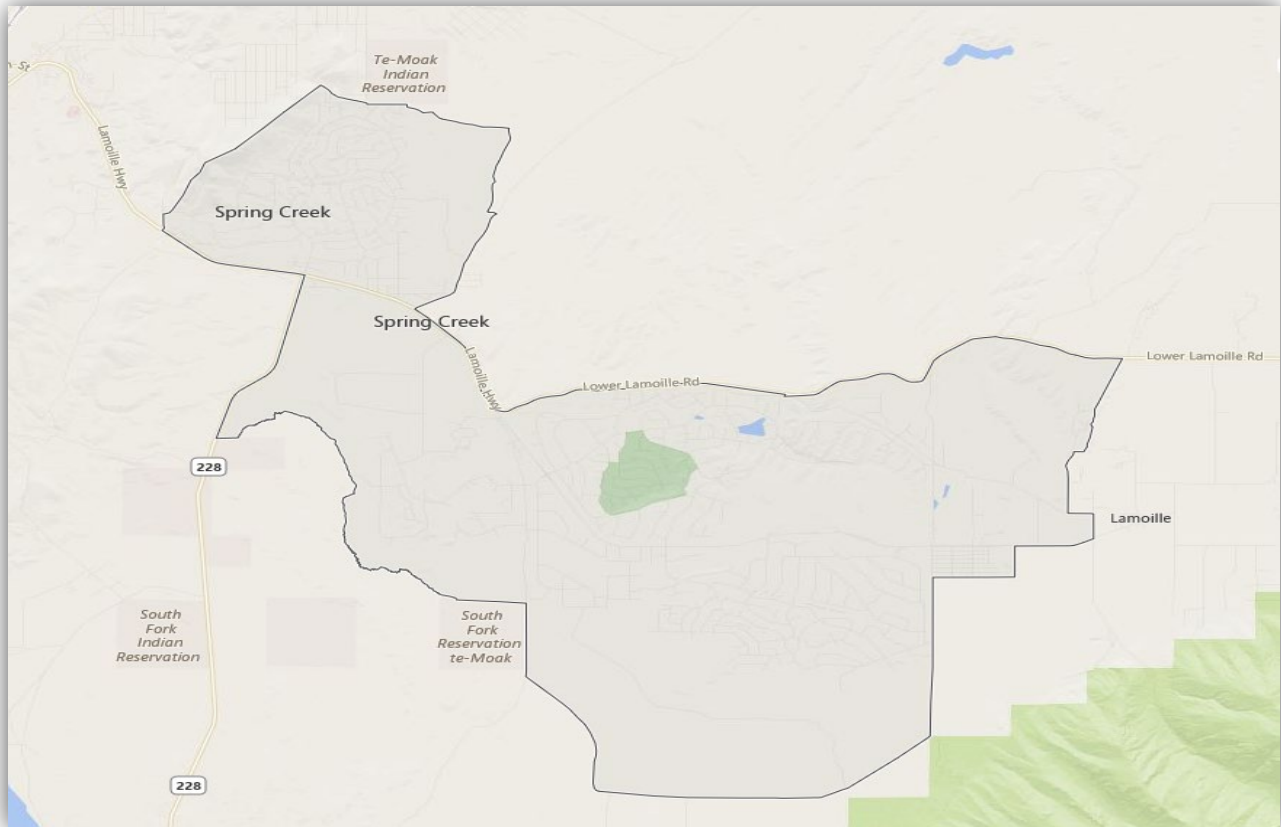
- Develop inventory and treatment strategies for new noxious weed infestations, specifically EDRR weed species.

Monitoring and Maintenance

- Strengthen and expand cooperative weed management areas that include private, municipal, university, county, state, tribal and federal land interests.
- Prioritize and implement ecologically based integrated weed management programs.
- Combine invasive plant control with the establishment of desired plant species to help improve the chance of restoration success.

Location and Land Status

Spring Creek is located in a large valley between the Elko Hills to the northwest, and the Ruby Mountains to the southeast. The community was developed in the 1970s by C. V. Wood, president of McCulloch Oil, as four large housing sections (tracts) and numerous amenities that are enjoyed year-round by HOA residents.



Severity of Noxious Weeds Within the Association Boundaries

The Nevada Revised Statutes (NRS) defines a noxious weed as "any species of plant which is, or likely to be, detrimental or destructive and difficult to control or eradicate." Per NRS 555.005 "The State Quarantine Officer may declare by regulation the weeds of the state that are noxious weeds, but a weed must not be designated as noxious which is already introduced and established in the State to such an extent as to make its control or eradication impracticable in the judgment of the State Quarantine Officer." All noxious weeds are regulated by the Nevada Department of Agriculture (Appendix A).

At the present time, the Spring Creek Association (SCA) has areas that range from weed-free to totally infested. If existing weed infestations are not controlled, a major weed problem could develop in a very short period of time without prompt identification and diligent control. Increased vegetation and soil disturbance resulting from subdivision of land into residential and recreational areas, as well as increased use of public and private lands will likely result in increased levels of weed seed transportation, and subsequent establishment of weed populations in un-infested areas. It is imperative that the SCA with coordination from contractors and landowners continues to monitor weed populations throughout the HOA and initiate control programs before weed densities become unmanageable or create irreversible damage to ecosystems on both public and private properties.

The spread of noxious and invasive weeds across the landscape has been compared to an explosion in slow motion. Unlike other forms of pollution that dissipate or accumulate, weeds reproduce themselves exponentially. Without sufficient action, the weed infestations could potentially become unmanageable.. Highly damaging to agriculture, rural landscapes, and the natural environment, these plants are “out of place” and interfere with beneficial uses of the land.

Plan of Work

A. Objectives and Goals

- Develop and implement a comprehensive noxious weed management program
- Educate the public concerning weed management issues, and importance of EDRR
- Foster a spirit of cooperation among federal, state and local government agencies, private landowners and neighboring communities, ie. Jiggs and Lamoille Conservation Districts
- Work with other government agencies and departments to institute “Best Management Practices” and/or policies that stress prevention as a weed management tool
- Promote and use integrated management techniques
- Establish and maintain healthy plant communities with native or beneficial vegetation
- Restore and maintain desirable plant communities, healthy ecosystems, and productive agricultural lands within the Spring Creek Association jurisdictional boundaries
- Stop the spread of noxious weeds to un-infested lands
- Contain heavily weed-infested areas

- Management Goals for Weed Species

Management goals will vary from species to species, by location, and over time. For some species, such as Scotch thistle and poison hemlock, complete eradication of existing infestations and total suppression of newly identified infestations is feasible and appropriate. Containment of existing intentional plantings, exclusion of seed from new wild land or open space mixes, and elimination of targeted escaped infestations are three different management goals for certain ornamentals such as oxeye daisy. Spotted knapweed, various thistles, and Dyer’s woad infestations are so widespread that they must be managed, in many cases, merely for containment and reduction in the rate of spread. Eradication of these stands may only be viewed as impossible in some instances or as long range objectives.

- SCA Treatment and Revegetation Priorities (Appendix A)

The Spring Creek Association staff will be responsible for treating and maintaining Spring Creek’s amenities, listed below, to ensure higher property values and quality of living for SCA residents. Each amenity will be maintained yearly; control over the noxious weeds takes persistence and community wide involvement. Annual weed treatment timeline for staff per amenity is as follows:

- Schuckmann’s Sports Complex
 - Canada thistle

- Treatment – apply appropriate herbicide to rosettes up to bolting stage from late May to early June, wait to mow one week following treatment
- Burr buttercup
 - Treatment - apply appropriate herbicide to rosettes late March to early April before plants go to flower
- Spotted knapweed
 - Treatment - apply appropriate herbicide to rosettes up to flower bud stage early May to late June before plants go to flower, also in the fall to emerging rosettes. Wait to mow one week following treatment
- Vista Grande Park
 - Canada thistle
 - Treatment – apply appropriate herbicide to rosettes up to bolting stage from late May to early June, wait to mow one week following treatment
 - Burr buttercup
 - Treatment - apply appropriate herbicide to rosettes late March to early April before plants go to flower
 - Spotted knapweed
 - Treatment - apply appropriate herbicide to rosettes up to flower bud stage early May to late June before plants go to flower, also in the fall to emerging rosettes. Wait to mow one week following treatment
- Marina
 - Canada thistle, Scotch thistle, musk thistle, Dyer’s woad, hoary cress, perennial pepperweed, poison hemlock
 - Treatment – apply appropriate herbicide to rosettes up to bolting stage from late May to early June, wait to mow one week following treatment
 - Spotted knapweed
 - Treatment - apply appropriate herbicide to rosettes up to flower bud stage early May to late June before plants go to flower, also in the fall to emerging rosettes. Wait to mow one week following treatment
 - Leafy spurge
 - Treatment - apply appropriate herbicide to flowering growth stage early to late June before plants go to seed, wait to mow one week following treatment
- Green Belts
 - Canada thistle, Scotch thistle, musk thistle, Dyer’s woad, hoary cress, perennial pepperweed, poison hemlock
 - Treatment – apply appropriate herbicide to rosettes up to bolting stage from late May to early June, wait to mow one week following treatment

- Spotted knapweed
 - Treatment - apply appropriate herbicide to rosettes up to flower bud stage early May to late June before plants go to flower, also in the fall to emerging rosettes. Wait to mow one week following treatment
- Leafy spurge
 - Treatment - apply appropriate herbicide to flowering growth stage early to late June before plants go to seed, wait to mow one week following treatment
- Rights-of-Way
 - Canada thistle, Scotch thistle, musk thistle, Dyer's woad, hoary cress, perennial pepperweed, poison hemlock
 - Treatment – apply appropriate herbicide to rosettes up to bolting stage from late May to early June, wait to mow one week following treatment
 - Spotted knapweed
 - Treatment - apply appropriate herbicide to rosettes up to flower bud stage early May to late June before plants go to flower, also in the fall to emerging rosettes. Wait to mow one week following treatment
 - Leafy spurge
 - Treatment - apply appropriate herbicide to flowering growth stage early to late June before plants go to seed, wait to mow one week following treatment
- Campground and Shooting Range
 - Canada thistle, Scotch thistle, musk thistle, Dyer's woad, hoary cress, perennial pepperweed, poison hemlock
 - Treatment – apply appropriate herbicide to rosettes up to bolting stage from late May to early June, wait to mow one week following treatment
 - Spotted knapweed
 - Treatment - apply appropriate herbicide to rosettes up to flower bud stage early May to late June before plants go to flower, also in the fall to emerging rosettes. Wait to mow one week following treatment
 - Leafy spurge
 - Treatment - apply appropriate herbicide to flowering growth stage early to late June before plants go to seed, wait to mow one week following treatment
- Horse Palace
 - Canada thistle, Scotch thistle and musk thistle
 - Treatment – apply appropriate herbicide to rosettes up to bolting stage from late May to early June, wait to mow one week following treatment

- Burr buttercup
 - Treatment - apply appropriate herbicide to rosettes late March to early April before plants go to flower
- Spotted knapweed
 - Treatment - apply appropriate herbicide to rosettes up to flower bud stage early May to late June before plants go to flower, also in the fall to emerging rosettes. Wait to mow one week following treatment
- Golf Course
 - Canada thistle, Scotch thistle, musk thistle, Dyer's woad, hoary cress, perennial pepperweed, poison hemlock
 - Treatment – apply appropriate herbicide to rosettes up to bolting stage from late May to early June, wait to mow one week following treatment
 - Spotted knapweed
 - Treatment - apply appropriate herbicide to rosettes up to flower bud stage early May to late June before plants go to flower, also in the fall to emerging rosettes. Wait to mow one week following treatment
 - Leafy spurge
 - Treatment - apply appropriate herbicide to flowering growth stage early to late June before plants go to seed, wait to mow one week following treatment

B. Prevention and Detection (Appendix B)

Prevention is the highest priority weed management technique on non-infested lands. Among government officials, land managers, farmers, ranchers, and the general public there is growing recognition that protecting weed-free plant communities is the most economical and efficient land management practice. The benefits are obvious. Weed-free plant communities:

- Provide essential wildlife habitat and forage
- Saves local ranchers, farmers, taxpayers, landowners, etc. in labor and production costs
- Ensure aesthetic and recreational qualities of an area
- Prevents soil erosion and improves water quality

The spread of noxious weeds is most likely to occur where soil has been disturbed either by human activities (road and trail cuts, construction sites, the spread of gravel, road fill and topsoil contaminated with noxious weed seed, or overgrazing) or by natural disturbances (fire, avalanches, mudslides, flooding). Disturbed land provides opportunity for noxious weeds. All soil disturbances should be monitored by the appropriate entity for noxious weed outbreaks, regular monitoring enables the practice of EDRR.

Exotic plants and seeds such as oxeye daisy, purple loosestrife, chicory, toadflax, and Russian olive escape from our yards and gardens. Since they are attractive and establish themselves quickly, they are popular with landscapers and gardeners for ornamental planting and may be purchased through nurseries. They have the same ability to dominate and spread, however, as other better known noxious weeds.

Still other known methods of weed introduction include:

- Contaminated seed, feed grain, hay, straw, and mulch.
- Movement of contaminated equipment, cars, bikes, etc. across uncontaminated lands.
- Animal fur, fleece, human clothing.
- Dried flower arrangements.

Prevention is best accomplished by ensuring that new weed species seed or vegetative reproductive plant parts of weeds are not introduced into new areas and by early detection and management of any new weed species before they become widespread.

STRATEGIES to prevent the introduction or establishment of noxious weeds into new un-infested areas include:

- Identification and eradication of small, new infestations.
- Continuous monitoring and evaluation to prevent recurrence.
- Identification of existing conditions, disturbances, and activities that represent a potential threat to native habitat.
- Identification of recently introduced weed species that represent a future threat.
- Timely revegetation and reclamation of disturbed sites using appropriate native plant species.
- The use of weed free seeds and mulch.
- Countywide promotion of the Nevada Weed Free Gravel, Hay and Forage program.
- Prioritization of weed management along areas of entry and dispersal.
- Discouraging the sale of weedy ornamental plants and seed packets that contain weeds.

C. Education and Awareness:

Education must play a major role in implementing this weed management plan. Groups targeted for public education include the following: farmers and ranchers, homeowners, recreational users, youth groups and schools.

A partnership of the public and private sectors, along with awareness of what noxious weeds are and the problems they cause, is essential to maintain or create plant communities that are free of noxious weeds. Knowledge about how to identify weeds, how and where weeds are spread, and what it takes to manage weeds is needed. Continuation and expansion of current educational programs as well as the development of new programs is a priority of the Spring Creek Association Noxious Weed Management Plan. Workshops will be held throughout the year to enhance public awareness.

OPPORTUNITIES for education include:

- Yearly Weed Extravaganza that is held in Elko every March, where participants can test to become certified applicators, learn about applicator safety, laws and regulations and network with agency representatives and other private landowners, applicator certification, applicator safety, and laws/regulations.
- Widespread distribution of informative printed material.

- Offer weed tours and talks to the public.
- Proper calibration of spraying equipment.
- Contacting area nurseries, landscapers, and landscape architects, to emphasize the problems created by escaped ornamentals.
- Cooperation with local media to disseminate weed information.
- Custom weed management recommendations for individual landowners.

D. Land Stewardship

The Nevada Noxious Weed Law requires that all property owners use integrated methods to manage noxious weeds. Weed management must be widespread and ongoing, requiring an integrated approach in which proper land stewardship practices are utilized. Most weed species, if detected early, can be managed.

STRATEGIES of good stewardship include:

- Identification of plant species. Is it native or noxious?
- Understand the target weed. Does it reproduce by seed or roots or both?
- Maintain weed inventory maps through the online inventory database EDDMapS.
- Develop a noxious weed database.
- Develop site specific weed management plans in cooperation with other individual landowners and public agencies.
- Develop a decision-making process that uses site-specific information to make decisions about treatment choices.
- Develop a long-term strategy including regular monitoring of treatment areas.
- Alleviate the situation, or practices, that allowed the weeds to spread.
- Take the necessary action to prevent further spread.

E. Revegetation and Rehabilitation

A crucial part of any weed management plan is the reintroduction of site appropriate vegetation. Establishing a desirable plant community after noxious weeds have been removed from a highly infested area requires timely cultivation and reseeding. Since the seeds from noxious weeds may lay dormant for many years, removing all visible signs of the noxious weeds does not ensure against their return. Revegetation can help prevent the germination of weed seeds. It is important to inspect the land within SCA jurisdictional boundaries regularly to identify and treat small, new infestations. For proper reclamation, managed irrigation of dry areas, fertilization, and reseeding with desirable and beneficial plant species are essential components for establishing desirable plant communities.

Native plants may or may not be the most appropriate when trying to establish desirable plants that will compete with the noxious weeds. When the goal is restoration to a native plant community, it may still require the use of some non-natives that can eventually be replaced with natives once the noxious weeds have been outcompeted and eradicated on the site. Weed-free seeds of native Nevada grasses, wildflowers or plant species appropriate to the site may be purchased, but the best source for seeds is from native species that grow in the immediate

vicinity of the infestation. They will be best adapted to local conditions and will help maintain local integrity and genetic viability. Using native plants or seeds to reclaim disturbed land reduces degradation of native ecosystems, reduces the need for herbicides and conserves water resources. Native plants will provide a broad biological diversity and help keep Nevada looking like Nevada with a unique regional landscape that sets us apart from other areas of the country.

When the goal is reclamation (reseeding for quick ground cover establishment or erosion control), it may be appropriate to use introduced, non-aggressive grasses and forbs. Please contact your local Cooperative Extension office or one of their partners for seeding recommendations. The Native Plant Revegetation Guide for Nevada, published by the Nevada State Parks Natural Areas Program, is an excellent guide for native plant reseeding.

STRATEGIES for successful rehabilitation and revegetation include:

- Study all vegetation in the area and surrounding areas.
- Preserve the beneficial plant species native to Nevada.
- Test the soil for pH balance. Try to retain and utilize as much on-site topsoil as possible.
- Select a predominant species that is appropriate to the site. Then choose a few complimentary species to provide a balanced plant community.
- Choose plants that are healthy, vigorous and pest free.
- Use weed-free seeds. Use non-hybrid seeds. Avoid commercial seed packets containing exotic plant species.
- Consider Weed Free forage and other materials (gravel, mulch, etc.)
- Choose plants that are horticulturally appropriate, i.e. plant species that are adaptable to climate, soil and topographical conditions of the designated area.
- Consider the use of water, its availability and the vegetative requirements.
- To landscape for wildlife, choose native plants that provide cover, forage, browse, seeds for birds and rodents, and shade.
- Be site-specific; revegetation strategies may vary for small lots, farms, ranches or construction sites.
- Establish a vegetative cover that is diverse, effective and long lasting, capable of self-regeneration.
- Stabilize the soil surface.

F. Land Disturbance Requirements (Soil Plan, Revegetation Plan & Security)

At the discretion of the Spring Creek Association Board, as part of the Planning and Zoning approval process for land disturbances, the following items may include:

1. Soil Plan for Contractors or Ground Disturbance (Appendix C):
 - Provisions for salvaging on-site topsoil.
 - A timetable for eliminating topsoil and/or aggregate piles.
 - A plan that provides for soil cover if any disturbances or stockpiles will sit exposed for a period of 90 days or more.

2. Revegetation Plan:

- Plant material list (be specific, scientific and common names required).
- Planting schedule (to include timing, methods, and provisions for irrigation, if applicable).
- A map of the area impacted at preliminary plan (where the soil will be disturbed).
- If applicable, revegetation seed should be drill seeded, otherwise broadcast will suffice.

Revegetation of newly disturbed sites will be approved and monitored by SCA staff and site-visits may be performed by SCA staff, if necessary:

G. Reclamation Standards

1. Site stability

The reclaimed area shall be stable and exhibit none of the following characteristics:

- Large rills or gullies.
- Perceptible soil movement or head cutting in drainages.
- Slope instability on or adjacent to the reclaimed area.
 - Slopes shall be stabilized using appropriate reshaping and earthwork measures, including proper placement of soils and other materials.

2. Soil Management

- Topsoil shall be salvaged from the areas to be disturbed, and properly managed for later use during reclamation.

3. Erosion Prevention

The surface area disturbed at any one time during the development of a project shall be kept to the minimum necessary and the disturbed areas reclaimed within ninety days to prevent unnecessary or undue degradation resulting from erosion.

- a. The soil surface must be stable and have adequate surface roughness to reduce run off, capture rainfall and snow melt, and allow for revegetation.
- b. Application of certified noxious weed free mulch or erosion netting may be necessary to reduce soil movement, retain soil moisture, and promote revegetation.
- c. Soil conservation measures, including surface manipulation, reduction in slope angle, revegetation, and water management techniques, shall be used.
- d. Sediment retention structures or devices shall be located as close to the source of the sediment generating activities as possible to increase their effectiveness and reduce environmental impacts.

4. Revegetation

When the final landform is achieved, the surface shall be stabilized by vegetation or other means to reduce further soil erosion from wind or water, provide forage and cover, and reduce visual impacts. Specific criteria for evaluating revegetation success may be site specific.

- a. Vegetation production, species diversity, and cover, shall support the post-disturbance land use. Areas where the post-disturbance land use does not include lawns, gardens, and flower beds; shall approximate the surrounding undisturbed area or be re-vegetated to a desired plant community with a composition of species and plant cover typical to that site.
- b. The vegetation shall stabilize the site and support the planned post-disturbance land use, provide natural plant community succession and development, and be capable of renewing itself. This shall be demonstrated by:
 - i. Using certified noxious weed free seed.
 - ii. Successful onsite establishment of the species included in the planting mixture and/or other desirable species.
 - iii. Evidence of desirable vegetation reproduction, either spreading by rhizomatous species or seed reproduction.
 - iv. Evidence of overall site stability and sustainability.
- c. The revegetation plan shall provide for the greatest probability of success in plant establishment and vegetation development by considering environmental factors such as seasonal patterns of precipitation, temperature and wind; soil texture and fertility; slope stability; and direction of slope faces.
- d. To insure the establishment of a diverse and long-lasting vegetative cover, the Spring Creek Association landowners shall employ appropriate techniques of site preparation and protection. Species diversity should be selected for long-term land uses and to provide for a reduction in visual contrast.
- e. Where revegetation is to be used, a diversity of vegetation species shall be used to establish a resilient, self-perpetuating ecosystem capable of supporting the post- disturbance land use. Species planted shall include those that will provide for quick soil stabilization, provide litter and nutrients for soil building and are self-renewing.
- f. Integrated Weed Management (IWM) methods shall be employed for all weed species on the NDA noxious weeds list. Weed management methods shall be used whenever the inhabitation of the reclaimed area by noxious weeds threatens nearby areas.
- g. Where revegetation is impractical or inconsistent with the surrounding undisturbed areas, other forms of approved surface stabilization shall be used.

H. Weeds to Watch (Appendix D)

- Black henbane
- Bur buttercup
- Canada thistle
- Dyer's woad
- Hoary Cress
- Leafy spurge
- Medusahead
- Perennial pepperweed
- Poison hemlock

- Puncturevine
- Russian knapweed
- Spotted knapweed
- Scotch thistle

I. Mapping and Inventory

Inventory and weed mapping come first and are a valuable tool in integrated weed management. As such, the HWCWMA Coordinator will train SCA staff how to map and inventory noxious weeds as well as establish and maintain accurate visual maps of past and present infestations of known noxious weeds on public and private land, if landowner is willing to cooperate. This process will provide a graphic representation of weed management progress and needs. The primary goal of mapping will be to record the noxious weed species present, areas infested, density of infestations, and other site factors pertinent to successful management of the infestation. The data will be periodically updated and compared to establish trends, and to evaluate the success of management methods being employed.

J. Monitoring

Even after apparently successful weed control, reinvasion by weeds from buried seeds or other underground plant fragments may occur before any native plant species occupy the area. Monitoring is required to assess the effectiveness of weed management and the expected recovery of native vegetation following weed removal or suppression. Without monitoring, we cannot learn about the impact of a management program or how it might be modified in the future, if necessary, for improved results. In planning a monitoring procedure, the SCA should consider the aims of the management program which is simply the removal of weeds and an increase in native (or other desired) species. When appropriate, the SCA will decide what to measure, how to measure and record it and the time-frame: the frequency of repeated measurements and the duration of the program. The monitoring procedure should be easily repeated and not subjective, so it could be done by different people over time and the same accuracy can be achieved.

Data collected during monitoring events would include: the noxious weed species, location information (GPS documentation and accompanying map products), the extent of the infestation, results of previous control measures implemented (if any), and recommendations for further control (if needed). Estimates would be made for the entire problem area, comparing disturbed and adjacent areas, and include the range of species cover and density values. SCA will consult with local Cooperative Extension agents and land management agencies to determine the most appropriate control measures. All noxious weeds identified within the SCA jurisdictional boundaries will be delineated via GPS units or mapping capable devices (sub meter accuracy).

References

1. DiTomaso, J.M. G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.
2. Donaldson, Susan and Mazet, Wendy Hansen. 2010. *A Northern Nevada Homeowners Guide to Identifying and Managing Bur Buttercup*. University of Nevada Cooperative Extension. Fact Sheet-

Appendix A: SCA Treatment and Revegetation Priorities

Treatment/Revegetation Timeline							
Objective	Strategy	Responsible Dept.	Estimated Cost	SCA's Known Noxious Weeds	Location	Treatment Spring/Summer (Growth Stage) *	Treatment Late Summer/Fall (Growth Stage) *
Treatment of SCA's Noxious Weeds: Rights-of-Way (ROWs), Common Areas and Green Strips	Treat weed infestations on a seasonal basis every year, which will lead to a reduction of weeds within SCA's jurisdictional boundaries.			Bur buttercup	Common areas	Rosette to bolting stage before flower develops	N/A
				Canada thistle	Common areas and green strips	Rosette to early bud stage	Rosette stage
				Dyer's woad	Green strips	Rosette to bolting stage before flower develops	N/A
				Hoary cress	Common areas and green strips	Rosette to early bud stage before flower develops	Rosette stage
				Leafy spurge	Green strips	Rosette up to flowering stage	N/A
				Musk thistle	ROWs, common areas and green strips	Rosette to young bolting stage	Rosette stage
				Poison hemlock	ROWs and green strips	Rosette stage	Rosette stage
				Perennial pepperweed	ROWs and green strips	Rosette to flowering stage	Rosette stage
				Scotch thistle	ROWs, common areas and green strips	Rosette to young bolting stage	Rosette stage
				Spotted knapweed	ROWs, common areas and green strips	Rosette to bolting stage	Rosette stage
Objective	Strategy	Responsible Dept.	Estimated Cost	Seed Mix/Blend	Location	Spring Timing	Fall Timing
Revegetation of SCA's Noxious Weeds: Rights-of-Way, Common Areas and Green Strips	Drill or broadcast native seed mix that will compete with noxious weeds.			Native perennial grass and forb mix	ROWs and green strips	N/A	Weather permitting: Mid-October to Mid-December

*For additional information, please refer to weed identification sheets from *Weed Control in Natural Areas in the Western United States*.

Appendix B: Nevada Department of Agriculture Designated Noxious Weeds Lists

Under the Nevada Revised Statutes (NRS 555), the Nevada Department of Agriculture maintains three different categories of noxious weed listings and the specific management goals for each category. The categories are as follows:

Category "A" Weeds

Weeds that are generally not found or that are limited in distribution throughout the State. Such weeds are rare and subject to active exclusion from the State and active eradication wherever found.

- African rue (*Peganum harmala*)
- Austrian fieldcress (*Rorippa austriaca*)
- Austrian peaweed (*Sphaerophysa salsula*)
- Barbed goatgrass (*Aegilops triuncialis*)
- Buffelgrass (*Pennisetum ciliare*)
- Camelthorn (*Alhagi maurorum*)
- Common crupina (*Crupina vulgaris*)
- Curly leaf pondweed (*Potamogeton crispus*)
- Desert knapweed (*Volutaria tubuliflora*)
- Dyer's woad (*Isatis tinctoria*)
- Eurasian water-milfoil (*Myriophyllum spicatum*)
- Flowering rush (*Butomus umbellatus*)
- Giant salvinia (*Salvinia molesta*)
- Goats rue (*Galega officinalis*)
- Green fountain grass (*Pennisetum setaceum*)
- Houndstongue (*Cynoglossum officinale*)
- Hydrilla (*Hydrilla verticillata*)
- Iberian starthistle (*Centaurea iberica*)
- Jointed goatgrass (*Aegilops cylindrical*)
- Klamath weed (*Hypericum perforatum*)
- Malta starthistle (*Centaurea melitensis*)
- Mediterranean sage (*Salvia aethiopis*)
- Purple loosestrife (*Lythrum salicaria*, *L. virgatum* & cultivars)
- Purple starthistle (*Centaurea calcitrapa*)
- Rush skeletonweed (*Chondrilla juncea*)
- Squarrose knapweed (*Centaurea virgata*)
- Sulfur cinquefoil (*Potentilla recta*)
- Syrian bean caper (*Zygophyllum fabago*)
- Ventenata (*Ventenata dubia*)
- Yellow starthistle (*Centaurea solstitialis*)
- Yellow toadflax (*Linaria vulgaris*)

Category "B" Weeds

Weeds that are generally established in scattered populations in some counties of the State. Such weeds are subject to eradication, containment or suppression in order to stop their continued spread.

- Black henbane (*Hyoscyamus niger*)

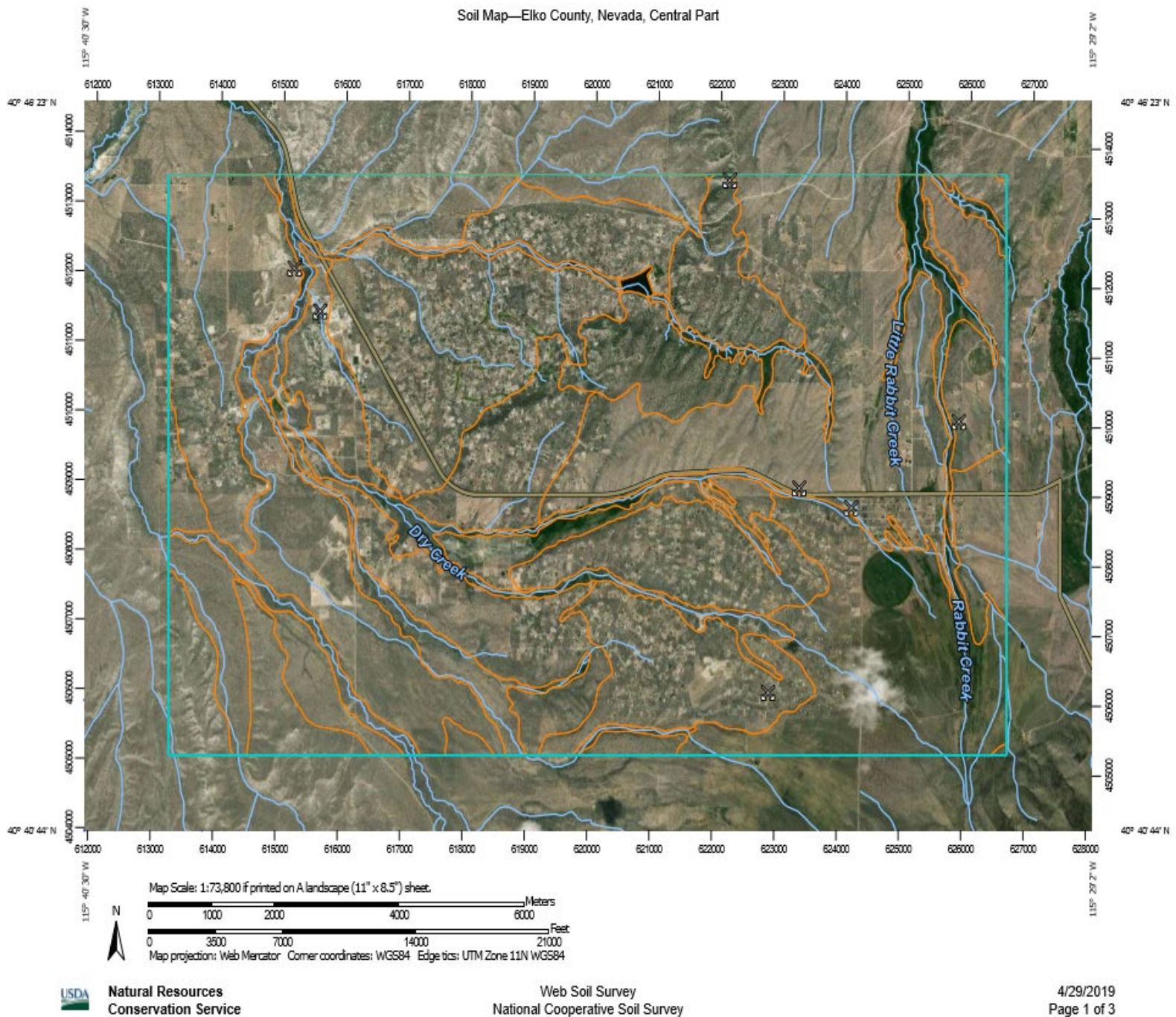
- Carolina horse nettle (*Solanum carolinense*)
- Dalmatian toadflax (*Linaria dalmatica*)
- Diffuse knapweed (*Centaurea diffusa*)
- Giant reed (*Arundo donax*)
- Leafy spurge (*Euphorbia esula*)
- Mayweed chamomile (*Anthemis cotula*)
- Medusahead (*Taeniatherum caput-medusae*)
- Perennial sow-thistle (*Sonchus arvensis*)
- Sahara mustard (*Brassica tournefortii*)
- Spotted knapweed (*Centaurea maculosa*)
- White horse nettle (*Solanum elaeagnifolium*)

Category "C" Weeds

Weeds that are generally established and generally widespread in many counties of the State. Such weeds are subject to improved management.

- Canada thistle (*Cirsium arvense*)
- Hoary cress (*Cardaria draba*)
- Johnson grass (*Sorghum halepense*)
- Musk thistle (*Carduus nutans*)
- Perennial pepperweed (*Lepidium latifolium*)
- Poison hemlock (*Conium maculatum*)
- Puncture vine (*Tribulus terrestris*)
- Russian knapweed (*Acroptilon repens*)
- Salt cedar (tamarisk) (*Tamarix spp.*)
- Scotch thistle (*Onopordum acanthium*)
- Water hemlock (*Cicuta maculata*)


Appendix C: NRCS Web Soil Survey for Spring Creek, NV





MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)




















Soils







 Soil Map Unit Polygons

 Soil Map Unit Lines


 Soil Map Unit Points

Special Point Features






-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Elko County, Nevada, Central Part
Survey Area Data: Version 12, Sep 13, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 19, 2009—Aug 7, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

4/29/2019
Page 2 of 3

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
184	Crooked Creek silty clay loam, frequently flooded, 0 to 2 percent slopes	464.7	1.7%
218	Netti-Stampede-Heechee association	6.3	0.0%
222	Enko-Zevadez-Puett association	1.6	0.0%
238	Cleavage-Tweener-Graley association	11.2	0.0%
283	Bloor-Connel-Kelk association	4,959.6	17.8%
323	Grina-Kelk-Orovada association	1,473.7	5.3%
442	Devilsgait-Crooked Creek association	2,003.5	7.2%
461	Stampede-Kleckner association	454.7	1.6%
479	Hunnton-Wieland-Bloor association	3,224.6	11.6%
482	Hunnton-Wieland-Hunnton, gravelly association	4,920.5	17.7%
485	Hunnton-Wieland-Wieland, moderately steep association	3,467.2	12.5%
490	Orovada-Bloya-Haybourne association	3,488.3	12.5%
491	Orovada-Puett association	48.6	0.2%
512	Dacker-Zevadez-Kelk association	3.2	0.0%
530	Uprville-Connel-Halleck association	2,654.9	9.6%
764	Yuko-Tuffo-Upsteer association	99.2	0.4%
1271	Wieland-Enko association	307.9	1.1%
1277	Wieland-Hunnton-Tustell association	175.7	0.6%
W	Water	33.3	0.1%
Totals for Area of Interest		27,798.5	100.0%



Appendix D: Most Prominent SCA Noxious Weeds

A **WEED REPORT** from the book *Weed Control in Natural Areas in the Western United States*

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center (wric.ucdavis.edu) or retail through the Western Society of Weed Science (wsweedscience.org) or the California Invasive Species Council (cal-ipc.org).

Hyoscyamus niger L.

Black henbane

Family: Solanaceae

Range: Most western states with the exception of Arizona and California.

Habitat: Disturbed open sites, roadsides, fields, waste places, abandoned gardens and other non-crop areas. Grows best in sandy or well-drained loam soils with moderate fertility.

Origin: Native to Eurasia and introduced to eastern North America in the early 1600s as a medicinal herb.

Impacts: All plant parts contain the tropane alkaloids hyoscyamine, scopolamine, and atropine and are toxic to humans and animals when ingested. Seeds have the highest concentration of alkaloids. Livestock rarely consume foliage because of the unpleasant odor and bitter taste. Most toxicity problems occur in humans that ingest seeds, particularly children and people who abuse black henbane for its neurological effects.

Western states listed as Noxious Weed: California, Colorado, Idaho, Nevada, New Mexico, Utah, Washington



Black henbane is an erect summer annual or biennial generally to about 3 ft, but it can grow to 6 ft tall under some conditions. The coarse foliage has sticky glandular hairs and a foul odor. The leaves are alternate, gray-green, oblong to lanceolate, 2 to 8 inches long, with coarsely toothed to acutely pinnate-lobed margins.

The inflorescence is a terminal raceme that is one-sided and somewhat coiled at the tip. Petals are fused and funnel-shaped with five unequal lobes. Flowers are 1 to 1.5 inches long and pale yellow to greenish with conspicuous purple veins and a purple throat. The calyx is persistent and urn-shaped, five-lobed and densely covered with long glandular hairs at the base. The fruit are capsules from 0.5 to 0.75 inch long and contain numerous seeds. Plants reproduce by seed only. Seeds disperse by falling at the base of the parent plants. Under field conditions, seeds appear to remain viable for up to about 4 years.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	Hand removal has been shown to offer some level of control, as has mowing and cultivation. Gloves should be worn for any hand removal as the plant is poisonous. Taproots must be removed to 2 inches below ground to ensure that resprouting does not occur. Mechanical methods should be repeated annually to exhaust the soil seed reserve.
Cultural	Plants with mature fruits can be burned to kill seed. Plants are poisonous, thus they are not recommended in a grazing control program.
Biological	There are no biological control agents available for black henbane.

CHEMICAL CONTROL

The following specific use information is based on published papers or reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS

2,4-D	Rate: 2 to 4 pt product/acre (0.95 to 1.9 lb a.e./acre)
Several names	Timing: Postemergence before flowering to prevent seed production and dispersal. Best applied to young plants.

	Remarks: 2,4-D is a restricted use herbicide in some areas. It will damage most broadleaf species.
Dicamba <i>Banvel, Clarity</i>	Rate: 1 to 2 pt product/acre (8 to 16 oz a.e./acre) Timing: Postemergence before flowering to prevent seed production and dispersal. Best applied to young plants from rosette to bolting stage. Remarks: Dicamba is a broadleaf herbicide with little soil activity.
Fluroxypyr <i>Vista XRT</i>	Rate: 15 to 22 oz product/acre (5.3 to 7.7 oz a.e./acre) Timing: Postemergence before flowering to prevent seed production and dispersal. Best applied to young plants from rosette to bolting stage. Remarks: Fluroxypyr is a broadleaf herbicide with little soil activity.
Picloram <i>Tordon 22K</i>	Rate: 1 to 2 pt product/acre (4 to 8 oz a.e./acre) Timing: Preemergence or postemergence in spring when plants are growing rapidly, but before bloom. Treatments can also be made in late summer for preemergence activity. Picloram can be used in a premix with 2,4-D (<i>Grazon P+D</i>) or tank mixed with 2,4-D at 1 lb a.e./acre. Remarks: Picloram is a restricted use herbicide. It is not registered for use in California.
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II, and others</i>	Rate: 2 to 4 qt product (<i>Roundup ProMax</i>)/acre (2.25 to 4.5 lb a.e./acre) Timing: Postemergence before flowering to prevent seed production and dispersal. Best applied to young plants. Remarks: Glyphosate provides effective control. It is nonselective and has no soil activity. Wiper applications for small patches can provide selectivity.
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron <i>Telar</i>	Rate: 0.5 to 1 oz product/acre (0.375 to 0.75 oz a.i./acre) Timing: Postemergence to rapidly growing plants from bolting to early flowering stage. Remarks: Chlorsulfuron is a very effective control option, but has a broad spectrum of susceptible species. Its residual soil activity gives effective control one year later. Chlorsulfuron can be applied in combination with metsulfuron in the premix trade name <i>Cimarron Plus</i> . This combination is not registered for use in California.
Metsulfuron <i>Escort</i>	Rate: 1 to 2 oz product/acre (0.6 to 1.2 oz a.i./acre) Timing: Postemergence to rapidly growing plants from bolting to early flowering stage. Remarks: Metsulfuron has some residual control activity. Use with a non-ionic or silicone-based surfactant. It can be applied in combination with chlorsulfuron in the premix trade name <i>Cimarron X-tra</i> . Metsulfuron is not registered for use in California.

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.



A Northern Nevada Homeowner's Guide to Identifying and Managing Bur Buttercup

Susan Donaldson, Water Quality and Weed Specialist

Wendy Hanson Mazet, Master Gardener Program Coordinator and Horticulturist

Other common names: Curveseed butterwort, little bur, testiculate buttercup

Scientific name: *Ceratocephala testiculatus*

Family: Ranunculaceae

Description: A small, 2- to 5-inch tall plant that grows and flowers early in spring, bur buttercup produces stiff burrs that help spread this weed. It is toxic to livestock.

Leaves: Grayish-green, hairy, and attached at the base of the plant. Leaf blades look like fingers.

Stems: Short; extend outward from the base of the plant.

Flowers: Small, yellow, with 2 to 5 petals. Blooms from late winter to early spring.

Fruit: Forms many stiff, brown burrs. This is the point at which most people notice the plant.

Roots: Short taproot.

Native to: Eurasia; naturalized throughout much of the western United States

Where it grows: Roadsides, vacant lots, in pavement cracks and other disturbed or unmanaged sites

Life cycle: Winter annual (sprouts in fall and early winter)

Reproduction: Reproduces by seed



Typical plant growing in disturbed site.
(photo courtesy of Gary A. Monroe @ USDA-NRCS
PLANTS Database)



Seedlings have divided leaves that
look like fingers.
(photo courtesy of Dr. Clinton C. Shock, Oregon
State University)

Control methods: Bur buttercup should be controlled prior to seed formation. As this occurs very early in the spring, careful monitoring is needed to stop the spread of this weed.

Mechanical: Dig, hoe or pull young seedlings.

Use mechanical control methods prior to formation of flowers and burrs.

Cultural: Thick mulches can help prevent seed germination. Plant desirable vegetation that will shade the area and reduce germination and growth of young plants.

Biological: None.

Chemical: Apply broadleaf-selective herbicides on young plants. Pre-emergence herbicides can be used to manage existing seed banks.

References:

- DiTomaso, J.M. and E.A. Healy. 2007. Weeds of California and Other Western States. University of California Publication 3488.
- USDA-NRCS Plants Database. No date. *Ceratocephala testiculatus* (Crantz) Roth, Curveseed Butterwort, <http://plants.usda.gov/java/profile?symbol=CETE5>
- Utah State University Cooperative Extension. 2010. Bur Buttercup. Range Plants of Utah, <http://extension.usu.edu/rangeplants/htm/bur-buttercup/>.
- Whitson, Tom D. (editor). 2002. Weeds of the West. University of Wyoming, Jackson, Wyoming.



The leaves are small and fingerlike.

(Photo by S. Donaldson)



Flowers are small, yellow and have 2 to 5 petals.

(photo courtesy of Dr. Clinton C. Shock, Oregon State University)



The seeds form in stiff burrs that turn brown in color when mature.

(Photo by S. Donaldson)

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This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center (wric.ucdavis.edu) or retail through the Western Society of Weed Science (wsweedscience.org) or the California Invasive Species Council (cal-ipc.org).

Cirsium arvense (L.) Scop.

Canada thistle

Family: Asteraceae

Range: Found throughout much of the United States, including all western states.

Habitat: Open, disturbed sites such as roadsides, gardens, pastures, hillsides, rangeland, stream banks, forest openings, and sometimes cropland such as alfalfa or grains. Prefers moist soils but will tolerate a wide range of soil types.

Origin: Native to southeastern Europe and the eastern Mediterranean area.

Impact: Competes aggressively with native plant species. It causes extensive yield loss in crops by competing for nutrients, light and water. It may also have an allelopathic effect. The productivity of pastures is significantly reduced because livestock avoid grazing Canada thistle and surrounding plants due to the spiny nature of the mature foliage. Canada thistle can also be economically damaging to ranchers by causing an increase in infections due to abrasions. Canada thistle is a host species for several agricultural insect and disease pests such as the sod-web worm, bean aphid, stalk borer, and cucumber mosaic virus.

Western states listed as a noxious weed: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming

California Invasive Plant Council (Cal-IPC) Inventory: Moderate Invasiveness



Canada thistle is an erect perennial that grows up to 3 to 5 ft tall and forms patches or clumps that are usually of a single sex. Stems ordinarily die back over winter and new shoots are formed in spring from old stem bases or root buds when the soil moisture permits. Canada thistle has an extensive creeping root system that can reach depths of 6 to 15 ft making eradication difficult. The spiny lobed leaves are 6 to 8 inches long and 1 to 1.5 inches wide. The leaves are alternate, oblong or lance-shaped and the base leaves stalkless and clasping.

Plants are dioecious (separate male and female plants) and flower heads are white to purple, borne in clusters of 1 to 5 per branch. The purplish involucre is glabrous or has white wooly hairs. Plants develop from seed and from vegetative shoots that generate from adventitious root buds. Canada thistle can produce between 1,000 and 5,000 seeds per stem. Most seeds fall near the parent plants or disperse short distances with wind. Birds and small mammals can consume and disperse some seeds. The seeds have been known to survive in the soil for up to 20 years and longevity is favored by deep burial.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	Mowing can be used to reduce the nutrient storage in the roots and suppress flower formation. However, for mowing to be effective it must be repeated at least every 3 to 4 weeks over several growing seasons or coupled with other control practices. Tillage or cultivation can actually increase Canada thistle because it breaks the root system into fragments, spreading the roots through the soil and stimulating development of new plants. Small root pieces have enough stored reserves to develop new plants. Small roots can survive at least 100 days without nutrient replenishment from photosynthesis. For cultivation to be effective it must be repeated at 21 day intervals throughout the growing season.
Cultural	Neither grazing nor prescribed burning have been shown to be effective for the management of Canada thistle.
Biological	Three insects have been released as biocontrol agents. None of these species have had a significant impact

	on Canada thistle.
	The larvae of the Canada thistle stem weevil (<i>Ceutorhynchus litura</i>) bore into the main leaf vein and then into the crown. It is considered the most effective of the current biocontrol agents, reducing plant vigor. When present in high enough densities it can kill the plant. Larvae of the bud weevil (<i>Larinus planus</i>) feed on the bud and can reduce the potential for sexual reproduction. Larvae of the thistle stem gall fly (<i>Urophora cardui</i>) bore into the apical meristem of shoots and form a gall. They can reduce plant vigor and can prevent flower formation depending upon the location of the gall.
	A pathogenic rust (<i>Puccinia punctiformis</i>) infects Canada thistle (mix sap from infected plant with water and spray uninfected plants to infect them), but it too has not had a significant effect on its control.

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D Several names	Rate: 2 qt product/acre (1.9 lb a.e./acre) Timing: Postemergence in spring at the pre-bud to early bud stage. Remarks: Control with 2,4-D alone is only temporary; therefore, it is commonly mixed with other growth regulator herbicides. Research from Colorado showed control from a spring 2,4-D application followed by fall application with different herbicides. 2,4-D is broadleaf-selective and has no soil activity. Do not apply ester formulation when outside temperatures exceed 80°F.
Aminocyclopyrachlor + chlorsulfuron <i>Perspective</i>	Rate: 4.75 to 8 oz product (<i>Perspective</i>)/acre Timing: Postemergent to plants before they produce seed. Remarks: <i>Perspective</i> provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. May need retreatment for 1 to 2 additional years. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).
Aminopyralid <i>Milestone</i>	Rate: 5 to 7 oz product/acre (1.25 to 1.75 oz a.e./acre) Timing: Postemergence in spring after all plants have fully emerged (some may be budding) until the oldest plants are in full flower stage. Use the higher rate when applying to flowering plants. Applications are also effective in fall before a killing frost. Use higher rates for older/dense stands or for longer residual control. Remarks: May need retreatment for 1 to 2 additional years. Aminopyralid is one of the most effective herbicides for the control of Canada thistle. It is safe on grasses, although preemergence application at high rates can greatly suppress invasive annual grasses, such as medusahead. Aminopyralid has a longer residual and higher activity than clopyralid. Other members of the Asteraceae and Fabaceae are very sensitive to aminopyralid. Other premix formulations of aminopyralid can also be used for Canada thistle control. These include <i>Opensight</i> (aminopyralid + metsulfuron; 2.5 to 3 oz product/acre) and <i>Forefront HL</i> (aminopyralid + 2,4-D; 1.5 to 2.1 pt product/acre), both applied at the rosette to bolting stages. The formulation with metsulfuron is not registered for use in California.
Clopyralid <i>Transline</i>	Rate: 0.67 to 1.33 pt product/acre (4 to 8 oz a.e./acre) Timing: Postemergence before the bud stage when most of the basal leaves have emerged. Fall applications are also effective. Remarks: One or more treatments per season may be needed for 1 to 3 consecutive years for complete control. Allow at least 20 days after application before disturbing treated areas. While clopyralid is very safe on grasses, it will injure many members of the Asteraceae, particularly thistles, and can also injure legumes, including clovers. Most other broadleaf species and all grasses are not injured. Also applied in a premix with triclopyr (<i>Redeem</i> , 2.5 to 4 pt product/acre) to rosette

	to bud stage Canada thistle.
Dicamba <i>Banvel</i>	<p>Rate: 4 pt product/acre (2 lb a.e./acre)</p> <p>Timing: Postemergence to rosettes. Fall applications are also effective.</p> <p>Remarks: Dicamba is a broadleaf-selective herbicide often combined with other active ingredients. It is not typically used alone to control Canada thistle because it is not as effective as other herbicides such as aminopyralid, clopyralid or aminocyclopyrachlor.</p> <p>Dicamba is available mixed with diflufenzopyr in a formulation called <i>Overdrive</i>. This has been reported to be effective on Canada thistle. Diflufenzopyr is an auxin transport inhibitor which causes dicamba to accumulate in shoot and root meristems, increasing its activity. <i>Overdrive</i> is applied postemergence at 4 to 8 oz product/acre to rapidly growing plants. Higher rates should be used when treating perennial weeds. Add a non-ionic surfactant to the treatment solution at 0.25% v/v or a methylated seed oil at 1% v/v solution.</p>
Picloram <i>Tordon 22K</i>	<p>Rate: 2 pt product/acre (8 oz a.e./acre).</p> <p>Timing: Best when applied postemergence to rapidly growing thistle after most leaves emerge but before bud stage. Fall applications are also effective.</p> <p>Remarks: Picloram gives a broader spectrum of control than aminopyralid, aminocyclopyrachlor, and clopyralid, and has much longer soil residual activity. Most broadleaf plants are susceptible. Although well-developed grasses are not usually injured by labeled use rates, some applicators have noted that young grass seedlings with fewer than four leaves may be killed. Do not apply near trees. <i>Tordon 22K</i> is a federally restricted use pesticide. Picloram is not registered for use in California.</p>
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II, and others</i>	<p>Rate: Broadcast foliar treatment: 2 qt product (<i>Roundup ProMax</i>)/acre (2.25 lb a.e./acre). Spot treatment: 2% v/v solution</p> <p>Timing: Postemergence to rapidly growing thistles when most plants are past the bud stage. Fall applications must be before the first killing frost.</p> <p>Remarks: Do not tank-mix other herbicides with glyphosate for thistle control. More than 1 year of treatment may be necessary for complete control. Glyphosate will only provide control during the year of application; it has no soil activity and will not kill seeds or inhibit germination the following season. Glyphosate is nonselective. To achieve selectivity, it can be applied using a wiper or spot treatment to control current year's plants.</p>
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron <i>Telar</i>	<p>Rate: 1 to 1.33 oz product/acre (0.75 to 1 oz a.i./acre)</p> <p>Timing: Postemergence from bolting to bloom stages. Can also apply in fall.</p> <p>Remarks: Chlorsulfuron has mixed selectivity on both broadleaf and grass species but is generally safe on most grasses. It has fairly long soil residual activity. The herbicide solution requires constant agitation during application.</p>
Imazapyr <i>Arsenal, Habitat, Stalker, Chopper, Polaris</i>	The herbicide label indicates that 4 to 6 pt product/acre gives some level of control, but imazapyr is not usually the herbicide of choice for the control of Canada thistle.
Sulfometuron <i>Oust and others</i>	<p>Rate: 6 to 8 oz product/acre (4.5 to 6 oz a.i./acre)</p> <p>Timing: Apply preemergence or early postemergence before or during the rainy season when weeds are germinating or actively growing.</p> <p>Remarks: Sulfometuron has mixed selectivity. It can cause minor damage to some native perennial grasses and has a fairly long soil residual. Higher rates may increase control but will also give more bare ground. Requires 20 inches of annual rainfall or more for effective preemergence control.</p>

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Isatis tinctoria L.

Dyer's woad

Family: Brassicaceae

Range: Throughout western U.S., except Arizona, North and South Dakota.

Habitat: Disturbed and undisturbed sites, roadsides, railroad rights-of-way, fields, pastures, grain and alfalfa fields, forest and rangeland. Often grows on dry, rocky or sandy soils. Most problematic on rangeland, in disturbed non-crop sites, and in undisturbed natural areas in the intermountain west.

Origin: Native to Europe. Was cultivated for centuries in Europe as a medicinal herb and source of blue dye, and was also cultivated by the early settlers of the eastern states.

Impact: Highly competitive and can grow in large, dense colonies that displace desirable rangeland species, crop plants, and native vegetation. It has a deep taproot (3 to 5 ft long), which makes it extremely competitive, especially on gravelly or sandy soil. The foliage contains compounds that appear to have insecticidal and fungicidal properties. The rotting seed pods are believed to be allelopathic.

Western states listed as Noxious Weed: Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, Wyoming

California Invasive Plant Council (Cal-IPC) Inventory: Moderate Invasiveness



Dyer's woad is an erect biennial, sometimes winter annual or short-lived perennial that grows to heights of 1 to 3 ft, occasionally 4 ft under ideal conditions. The leaves are bluish-green, with a pale midvein, and covered with a powdery white film. Rosette leaves are long and narrow, mostly 1.5 to 7 inches long, 0.4 to 1.5 inches wide, with weakly toothed to wavy margins. The stem leaves are broad to narrowly arrowhead-shaped, alternate and clasping the stem. Plants exist as basal rosettes until flower stems develop at maturity.

Dyer's woad reproduces only by seed. It flowers in spring, producing umbrella-shaped panicles with small, bright yellow, four-petaled flowers. These develop into hanging (pendant) blue/blackish fruits 8 to 18 mm long and 2.5 to 7 mm wide. After senescence, dried plants with a few fruits may persist well into winter. Most fruits fall near the parent plants, but some disperse short distances with wind and to greater distances with water, and as a seed and hay contaminant. New seedlings emerge in fall and early spring. Anecdotal evidence suggests the seedbank may persist for several years. Therefore, several consecutive years of control are generally necessary.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	<p>Hand pulling may be very effective provided the crown is removed. Hand pulling is easiest after the plants have bolted but should be done before seed set. It is important to visit the site 2 to 3 weeks later to rogue plants that have resprouted or were missed the first time through. It is necessary to follow up for several years to prevent reinfestation.</p> <p>Mowing is not effective due to resprouting from the crown, but mowing multiple times can reduce root reserves and seed production. Dyer's woad populations can be reduced if seed production can be prevented for a few years by cutting off the seed stalks and removing them from the field. Close clipping (2 inches from the soil surface) is more effective. This should be done as soon as possible after flowering to minimize resprouting and prevent seed production. Multiple visits to the field may be necessary to minimize seed production on resprouting plants.</p> <p>Spring cultivation can control infestations in crop fields but is not practical in most range settings.</p>
Cultural	<p>Livestock generally avoid eating dyer's woad. However, significant reductions in dyer's woad have been observed when livestock are forced under heavy grazing pressure to consume dyer's woad. The plant is more palatable before bolting and grazing should be done before flowering to minimize seed production.</p>

	The effect of fire on dyer's woad is not well known, but it is likely that even if fire kills the above-ground part of the plant, it will regenerate from root buds on the crown.
Biological	Insects for biological control of Dyer's woad are not available in the U.S. but are being evaluated. A native rust fungus (<i>Puccinia thlaspeos</i>) causes systemic infection in dyer's woad. Infected plants may appear chlorotic, stunted, malformed and have reduced seed production. Even though the disease is systemic, plants derived from the seed of infected plants did not show symptoms of infection. The effectiveness of this fungus is not known at this time.

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D Several names	Rate: Broadcast treatment: 2 to 3 qt/acre (1.9 to 2.85 lb a.e./acre). Spot treatment: 1% v/v solution Timing: Postemergence from seedling to rosette stages. Remarks: 2,4-D is broadleaf-selective and has no soil activity. It may require repeat application. It is an effective treatment for seedlings that may emerge following mechanical treatments. Do not apply ester formulations when outside temperatures exceed 80°F.
Aminocyclopyrachlor + chlorsulfuron <i>Perspective</i>	Rate: 4.75 oz product (<i>Perspective</i>)/acre Timing: Postemergence and preemergence. Postemergence applications are most effective when applied to plants from the seedling to the mid-rosette stage. Remarks: <i>Perspective</i> provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron <i>Telar</i>	Rate: 1 to 1.33 oz product/acre (0.75 to 1 oz a.i./acre) Timing: Preemergence or postemergence to seedlings and rosettes. Remarks: Chlorsulfuron has mixed selectivity, but is generally safe on grasses. Use a surfactant for postemergence applications. Chlorsulfuron is not recommended for late-season applications when the chances for rainfall for incorporation are low. The herbicide has long soil residual activity. <i>Telar</i> can be used near water, but cannot be applied to water.
Imazapic <i>Plateau</i>	Rate: 8 to 12 oz product/acre (2 to 3 oz a.e./acre) Timing: Postemergence to rosettes or bolting plants. Remarks: Imazapic will not injure most native grasses. It has mixed selectivity and tends to favor members of the Asteraceae and some grasses. It has some soil residual activity. Use a methylated seed oil surfactant at 0.25%. Imazapic is not registered for use in California.
Metsulfuron <i>Escort</i>	Rate: 0.5 to 1 oz product/acre (0.3 to 0.6 oz a.i./acre) Timing: Postemergence to rapidly growing plants up to early flowering. Remarks: Metsulfuron has mixed selectivity, but is generally safe on grasses. Tolerance to metsulfuron increases as the flowering stage progresses. This herbicide applied at any stage has been found to reduce seed development. It can be tank mixed with 2,4-D. Use a surfactant. Metsulfuron is not registered for use in California. Dyer's woad is also on the <i>Opensight</i> label (metsulfuron + aminopyralid) at 3.3 oz product/acre. However, this will provide only suppression and a second treatment may be necessary. The addition of 0.5 lb a.e./acre 2,4-D may improve control.

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center (wric.ucdavis.edu) or retail through the Western Society of Weed Science (wsweedscience.org) or the California Invasive Species Council (cal-ipc.org).

Cardaria chalepensis (L.) Hand.-Maz; lens-podded
whitetop (= *Lepidium chalepense* L.)

Cardaria draba (L.) Desv. ; hoary cress
(= *Lepidium draba* L.)

Cardaria pubescens (C.A. Mey.) Jarmolenko; hairy
whitetop (= *Lepidium appelianum* Al-Shehbaz)



Hoary cress (whitetop), lens-podded and hairy whitetop

Family: Brassicaceae

Range: Nearly all western states and many central and eastern states, except southeastern states

Habitat: Disturbed open sites, ditch banks, roadsides, wetlands and riparian areas, agricultural fields including pastures, alfalfa, grain, orchards and vineyards. Often on moderately moist, alkaline to saline soils, but tolerate a wide range of soil types and moisture conditions, especially wet areas.

Origin: Hoary cress is native to Eurasia, while lens-podded and hairy whitetop are native to Central Asia.

Impacts: Hoary cress is the most common and most aggressive of the three species. However, all three species can completely displace desirable vegetation forming dense monocultures. Once established, they can be very difficult to control. They are generally considered to be unpalatable to livestock.

Western states listed as Noxious Weed: *C. draba*, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, Wyoming; *C. chalepensis*, Arizona, California, Oregon; *C. pubescens*, Arizona, California, Oregon, Washington, Wyoming

California Invasive Plant Council (Cal-IPC) Inventory: *C. draba* and *C. chalepensis*, Moderate Invasiveness; *C. pubescens*, Limited Invasiveness

All three species of *Cardaria* are erect perennials up to 2 ft tall. The stems are generally erect and covered with short hairs. The leaves are alternate, gray-green, and variable in shape, some arrowhead shaped. The upper and especially the lower blade surface are covered with short white hairs. The basal leaves are short-stalked, and the upper leaves clasp the stem at their base. Leaves are 0.5 to 4 inches long by 0.1 to 1.5 inches wide. The basal leaves tend to be narrower but longer than stem leaves.

All three species reproduce by both seeds and through vegetative means. Numerous small, white, fragrant flowers appear in loose inflorescences in spring to summer. Flowers have four petals 2 to 4 mm long. They produce tiny pods that are heart-shaped to ovate. One plant can produce from 1,200 to 4,800 seeds. Seeds germinate in fall after the first rains. Under field conditions, seeds are short-lived. The three species also reproduce vegetatively, developing new shoots from their extensive system of vertical and horizontal roots. This is the primary method of spread. Within 3 weeks of germination the roots of seedlings can start producing buds. Root fragments also can generate new plants, but regeneration is poor in dry soils. The roots can penetrate deep into the soil, and depths well over 10 ft have been documented in some studies. Roots and rhizomes can account for 75% of the total plant biomass and store considerable amounts of carbohydrates. Carbohydrate reserves are minimal in early to mid-spring and accumulate to maximum levels by mid-summer. The foliage dies back during extended periods of freezing temperatures or drought, but the roots survive. Because of these large and deep underground systems, the three species form hard-to-control clonal colonies.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting,	Hand-pulling is fairly impractical with hoary cress due to its extensive root and rhizome system. Their roots can remain alive even when the top-growth has been eliminated for a year. However, hand hoeing at
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disking)	<p>intervals no longer than 4 weeks for 2 years has been effective.</p> <p>Mowing alone will not control the <i>Cardaria</i> species. A combination of mowing and competitive cropping has been used to control other <i>Cardaria</i> species and may work for hoary cress. In pasture, hoary cress has been controlled by ceasing irrigation, removing outlying plants, decreasing grazing, and generally managing for grassland health.</p> <p>Although improper cultivation can spread the <i>Cardaria</i> species by dispersing root fragments, its root systems can be exhausted through repeated cultivation. Repeat passes should be made within 10 days of weed emergence. It is important that no green leaves be allowed to form. This can eliminate colonies in 2 to 4 years. However, it is important to be aware that cultivation machinery can spread the roots of these species and increase infestations. All root fragments should be removed from machinery before it is moved to uninfested fields.</p> <p>Cultivation may be more successful in combination with competitive cropping, e.g., annual disking followed by planting alfalfa or grass forage crops.</p>
Cultural	<p>Sheep and goats will eat hoary cress and the other <i>Cardaria</i> species, especially the seedlings. Cattle tend to avoid eating them and those animals that consume it may have tainted milk. In addition, plants contain glucosinolates, which can form toxic compounds in cattle.</p> <p>Burning is not effective for controlling any of the <i>Cardaria</i> species. Fire will kill aboveground portions of the plant; however, plants will resprout because of their extensive root and rhizome system. Rhizomes have been found as deep as 4 ft and the root system much deeper. In addition, post-fire spread of <i>Cardaria</i>, particularly hoary cress, has been documented. Frequent searing with a weed burner at intervals less than 4 weeks apart has been found to be effective when continued for at least 2 years.</p> <p>Flooding an area with 6 to 10 inches of water for 2 months can be highly effective; however, short-term flooding (1 week) has no lasting impact.</p>
Biological	<p>Due to the taxonomic similarity to other important members of the mustard family, there are no biological control agents available for any of the <i>Cardaria</i> species.</p>

CHEMICAL CONTROL

The following specific use information is based on reports by researchers and land managers. Much of the information is based on trials for the control of hoary cress. It is expected that these options should also provide the same results with the other two *Cardaria* species. Other trade names may be available, and other compounds also are labeled for this weed. Chemical control is often impeded by the presence of annual grass biomass intercepting foliar applications. Timing for low annual grass presence is recommended.

Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D	Rate: 2 to 3 qt product/acre (1.9 to 2.85 lb a.e./acre)
Several names	<p>Timing: Postemergence early in the season before flowering, or to new growth in fall. Control is minimal after the bloom stage.</p> <p>Remarks: 2,4-D is broadleaf-selective and safe on grasses. This herbicide will most likely require repeat applications for several years. 2,4-D has little to no soil activity. It is not the most effective treatment, but widely used because of its low cost. 2,4-D is often combined with other active ingredients, e.g. clopyralid or dicamba. Do not apply the ester formulations when outside temperatures exceed 80°F.</p>
Aminocyclopyrachlor + chlorsulfuron	Rate: 3 to 4.5 oz product (<i>Perspective</i>)/acre
<i>Perspective</i>	<p>Timing: Postemergence or preemergence. Postemergence applications are most effective when applied to plants from the seedling to the mid-rossette stage.</p> <p>Remarks: <i>Perspective</i> provides broad-spectrum control of many broadleaf species. Aminocyclopyrachlor has marginal activity on mustards and control, when using <i>Perspective</i>, is largely from the chlorsulfuron component. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties</p>

	of Colorado (San Luis Valley).
Aminopyralid + metsulfuron <i>Opensight</i>	<p>Rate: 3.3 oz product/acre</p> <p>Timing: Optimum timing is when the plants are in the bloom stage.</p> <p>Remarks: Follow label restrictions. Not registered for use in California.</p>
Dicamba + 2,4-D	<p>Rate: 1 pt dicamba product/acre + 3 pt 2,4-D product/acre (0.5 lb a.e. + 1.5 lb a.e./acre)</p> <p>Timing: Postemergence from bolting to early bud stage.</p> <p>Remarks: See 2,4-D.</p>
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II,</i> and others	<p>Rate: Broadcast foliar treatment: 4 qt product (<i>Roundup ProMax</i>)/acre (4.5 lb a.e./acre). Spot treatment: 2% v/v solution</p> <p>Timing: Postemergence in the early bud stage.</p> <p>Remarks: Glyphosate is a nonselective herbicide. Spot treatment may be the best approach where feasible. Glyphosate has no soil activity. Repeat applications may be necessary. Drought stress will limit its effectiveness and its effectiveness is increased by the addition of ammonium sulfate.</p>
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron <i>Telar</i>	<p>Rate: 1 oz product/acre (0.75 oz a.i./acre)</p> <p>Timing: Postemergence from bud to bloom stages, or to rosettes in fall.</p> <p>Remarks: Chlorsulfuron is one of the most effective treatments for treatments for control of the <i>Cardaria</i> species. It has mixed selectivity, but is generally safe on grasses. 2,4-D at 1 to 2 pt product/acre can be tank-mixed with chlorsulfuron for quicker burndown. Use a surfactant. Chlorsulfuron has fairly long soil residual activity. <i>Telar</i> can be used near water, but cannot be applied to water.</p>
Imazapic <i>Plateau</i>	<p>Rate: 8 to 12 oz product/acre (2 to 3 oz a.e./acre)</p> <p>Timing: Postemergence after blossoms open until plants desiccate. Fall rosettes may also be treated.</p> <p>Remarks: Imazapic is safe to apply to most native grasses. Higher rates may suppress seed of some cool-season grasses. Imazapic is not registered for use in California.</p>
Imazapyr <i>Arsenal, Habitat, Stalker,</i> <i>Chopper, Polaris</i>	<p>Rate: 1 to 2 pt product (<i>Habitat</i>)/acre (0.25 to 0.5 lb a.e./acre)</p> <p>Timing: Most effective when applied postemergence in spring when plants are flowering.</p> <p>Remarks: Imazapyr is a nonselective herbicide. It has long soil residual activity and leaves more bare ground than other treatments, even a year after application. Add a spray adjuvant.</p>
Metsulfuron <i>Escort</i>	<p>Rate: 1 oz product/acre (0.6 oz a.i./acre)</p> <p>Timing: Postemergence from pre-bloom to bloom stages or to rosettes in fall.</p> <p>Remarks: The effectiveness of metsulfuron is similar to chlorsulfuron. It has mixed selectivity, but is generally safe on grasses. Use a surfactant. Metsulfuron can be tank-mixed with 2,4-D for quicker burndown. Other premix formulations of metsulfuron can be used at similar application timing. These include <i>Cimarron Max</i> (metsulfuron + dicamba + 2,4-D), <i>Opensight</i> (metsulfuron + aminopyralid), and <i>Cimarron X-tra</i> (metsulfuron + chlorsulfuron). Metsulfuron typically controls hoary cress for more than one season, but its soil activity is marginal, and seedlings of <i>Cardaria</i> species may invade shortly after application. Metsulfuron is not registered for use in California.</p>
Sulfometuron <i>Oust</i> and others	<p>Rate: 3 to 5 oz product/acre (2.25 to 3.75 oz a.i./acre)</p> <p>Timing: Preemergence or postemergence during or just before the rainy season when the target plants are germinating and growing rapidly.</p> <p>Remarks: Add a surfactant to improve control. Sulfometuron has a long soil residual and is susceptible to off-site movement in dry light windblown soils. Use with extreme care if near crops.</p>

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

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Euphorbia esula L.; leafy spurge
(= *E. virgata* Waldst. & Kit. [Jepson Manual 2012])
Euphorbia oblongata Griseb.; oblong spurge
Euphorbia terracina L.; carnation spurge

Leafy, oblong and carnation spurge

Family: Euphorbiaceae

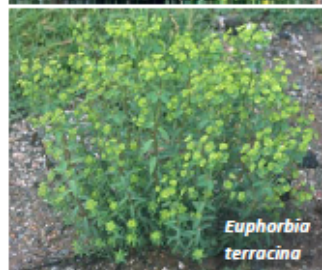
Range: Leafy spurge is found in all western states, most central states (especially in the north), and northeastern states. Oblong spurge is found in the Pacific Northwest states (Washington, Oregon and California) and is expanding its range in California. Carnation spurge, a recent introduction, is known only in southern California.

Habitat: Waste areas, disturbed sites, roadsides, fields. Leafy spurge also infests pastures, rangeland, and riparian areas, from sub-tropic to sub-arctic climates and from semi-arid to mesic conditions; it can even tolerate flooding for 4 to 5 months if shoots can grow above the water surface. Carnation spurge has been reported in disturbed places, grassland, coastal bluffs and dunes, salt marsh, riparian areas, and oak woodlands.

Origin: All species are native to southern Europe.

Impacts: These plants can form dense patches that displace desirable vegetation. Leafy spurge, in particular, is one of the most tenacious weeds in the United States, forming dense clonal colonies that suppress both native plants and forage, resulting in reduced land values. Leafy spurge is especially problematic in the north-central states and adjacent parts of Canada. It infests nearly 3 million acres of rangeland in 29 states, causing estimated economic losses of \$130 million per year. The milky sap of spurges is toxic and can irritate the skin, eyes, and digestive tracts of humans and other animals. Cattle avoid foraging spurge, but goats and sheep appear tolerant to its irritant properties.

Western states listed as Noxious Weed: *E. esula*, Arizona, California, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming
California Invasive Plant Council (Cal-IPC) Inventory: *E. esula*, High Invasiveness (Alert); *E. oblongata*, Limited Invasiveness; *E. terracina*, Moderate Invasiveness (Alert)



These spurges are erect perennials to nearly 3 ft tall (carnation spurge sometimes taller), with milky white sap and smooth, oblong to elliptical leaves. The leaves are alternate on the lower stems, but leaves and bracts may be whorled or opposite just under the flowering branches. Oblong and carnation spurges develop vertical taproots that can bud off new plants near the soil surface. Leafy spurge forms an extensive system of creeping roots that form adventitious root buds and generate new plants, as well as storing food reserves that enable roots to produce new shoots for many years under continuous grazing or mowing.

During summer, these spurges form umbel-like flower clusters at the stem tips, the flowers with yellow-green bracts (not petals). The flowers develop 3-chambered seed capsules with yellow-brown to grey seeds. Mature capsules rupture and eject seeds up to 16 ft from the parent plant, but some seeds disperse to greater distances with human and animal activities, water, and as hay or seed contaminants. These species generally start new infestations from seed. Leafy spurge populations also can expand vegetatively, by budding from

roots or from root fragments as small as 0.5 inch. Most seeds germinate in early spring, but germination may occur throughout the growing season. Seeds can remain viable for 8 years or more in the field.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	<p>Hoeing, grubbing, or hand pulling before seed production may be used for small patches. These control methods must be repeated several times over the growing season (2 to 3 week intervals), and for several years. Use gloves when handling leafy spurge due to the irritating effects of the latex.</p> <p>Mowing is generally not very effective for reducing perennial spurge infestations. However, mowing every 2 to 4 weeks can reduce seed production. Mowing may result in more uniform regrowth, which is more conducive to uniform and effective herbicide applications.</p> <p>Two cultivations in fall to a depth of at least 4 inches will help reduce infestations. (A single cultivation may only spread sprouting root fragments.) This should be conducted for 2 to 3 years. Cultivation twice each fall for 3 consecutive years completely controlled leafy spurge in North Dakota. In other habitats, heavy cultivation every 2 weeks during the growing season and every 3 weeks during the late summer and fall for 2 or more years will reduce top growth and regenerating buds, and eventually stress the root system. Clean equipment after cultivating to avoid transporting root fragments.</p>
Cultural	<p>Spurges are toxic to cattle and horses, but goats and sheep have been successfully used in control programs. Graze in spring when spurges emerge. Stock sheep at 3 to 6 head/acre month, or Angora goats at 12 to 16 head/acre month. These animals will not eradicate perennial spurges but can reduce the seedbank and allow grasses to become established. Animals should be held in a pen for 3 to 5 days before moving to a new area to prevent seed dispersal. Avoid overgrazing and excessive disturbance in pastures and rangelands, and reduce cattle stocking rates in areas of known infestations. An integrated strategy of early grazing followed by herbicide application to fall regrowth has proven more effective than either strategy alone.</p> <p>Burning does not significantly affect roots and typically stimulates the production of new shoots from root buds. Burning before release of biocontrol insects can help these insects to become established. Burning does not appear to harm biocontrol populations once established.</p>
Biological	<p>Fifteen non-indigenous insect species have been approved for release in the United States for the control of leafy spurge. Five flea beetles (<i>Aphthona</i> spp.) have been established in the Great Plains and Pacific Northwest. <i>Aphthona nigriscutis</i> and <i>A. czwalinae/lacertosa</i> impact the plant by ovipositing eggs at the base of the plant; the larvae feed on the roots, increasing plant morbidity, reducing plant health and creating pathways for the introduction of plant pathogens. Several moths (<i>Chamaesphecia</i> spp. and <i>Hyles euphorbiae</i>) and a stem-boring beetle (<i>Obera erythrocephala</i>) also are being tested. <i>Aphthona</i> spp. flea beetles have produced the greatest impact on leafy spurge, reducing stem densities by as much as 80 to 90% over large areas. This has not occurred in all areas. It is hoped that <i>Aphthona</i> spp. and other insects may eventually provide long term leafy spurge suppression over much of the western United States.</p>

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. The information here is primarily from information on the management of *E. esula*. It is considered that the same effects would also occur with *E. oblongata* and *E. terracina*. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D	Rate: 1 to 6 qt product/acre (0.95 to 5.7 lb a.e./acre)
Several names	<p>Timing: Postemergence at flowering in early summer, or on fall regrowth.</p> <p>Remarks: 2,4-D is broadleaf-selective and has no soil activity. It can prevent seed formation but does not provide complete kill and will require multiple treatments. One qt product/acre will suppress seed production, 6 qt will control shoots. Do not apply when outside temperatures exceed 80°F.</p>
Aminocyclopyrachlor + chlorsulfuron	Rate: 4.75 to 8 oz product/acre
Perspective	<p>Timing: Postemergence in spring up to flowering, or in fall rosette stage.</p> <p>Remarks: Perspective provides broad-spectrum control of many broadleaf species. Although</p>

	generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).
Dicamba <i>Banvel, Clarity</i>	Rate: 1 to 2 qt product/acre (1 to 2 lb a.e./acre) Timing: Postemergence in spring to early summer. Remarks: Dicamba is a broadleaf-selective herbicide often combined with other active ingredients. May require 3 consecutive years of treatment.
Dicamba + 2,4-D amine	Rate: 1 qt/acre each product Timing: Postemergence in spring at flower emergence and/or to fall regrowth. Remarks: Add non-ionic surfactant at 0.25%. Do not apply when outside temperatures will exceed 80°F.
Fluroxypyr <i>Vista XRT</i>	Rate: 22 oz product/acre (7.7oz a.e./acre) Timing: Postemergence when weeds are small and rapidly growing. Remarks: This rate provides only suppression of leafy spurge.
Picloram <i>Tordon 22K</i>	Rate: 1 to 2 qt product/acre (0.5 to 1 lb a.e./acre) Timing: Applications postemergence at true flower stage are most effective but it can also be applied in fall. The 1 qt product/acre rate may need to be applied annually for 3 to 4 years. <i>Tordon 22K</i> at 2 qt/acre can be applied every other year. Remarks: Picloram is one of the most effective herbicides for this weed. Most broadleaf plants are susceptible, but relatively safe on established grasses. Use non-ionic surfactant at 0.25%. Picloram has a long residual activity and some have reported that it may injure young or germinating grasses. Do not apply near trees. <i>Tordon 22K</i> is a federally restricted use pesticide. Not registered for use in California.
Picloram + 2,4-D	Rate: 1 to 1.5 pt picloram product/acre + 2 to 3 pt 2,4-D product/acre Timing: Postemergence in spring, at true flowering. Apply for 3 to 5 consecutive years. Remarks: See picloram, 2,4-D.
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II, and others</i>	Rate: 1 pt product (<i>Roundup ProMax</i>)/acre (0.56 lb a.e./acre) applied three times in a growing season, or 2 pt product (<i>Roundup ProMax</i>)/acre (1.1 lb a.e./acre) applied twice in a growing season Timing: Postemergence in split applications (June, July, August at low rate, or June and July at high rate), or apply a high rate in fall followed by spring treatment with glyphosate or 2,4-D. Remarks: Glyphosate is a nonselective herbicide. It has no soil activity. Its effectiveness is increased by addition of ammonium sulfate. Glyphosate is more effective when coupled with revegetation with competitive perennial grasses.
Glyphosate + 2,4-D	Rate: 1 pt glyphosate product/acre + 1.5 pt/acre of 2,4-D product (glyphosate at 6 oz a.e./acre + 2,4-D at 11 oz a.e./acre) Timing: Postemergence in late spring just before seed set. Remarks: This tank mix appears to provide synergistic control. Treatment should be repeated for 3 years. See remarks for glyphosate, 2,4-D.
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Imazapic <i>Plateau</i>	Rate: 8 to 12 oz product/acre (2 to 3 oz a.e./acre) Timing: Preemergence or early postemergence in fall when plants begin to grow but before hard freeze. More than one treatment will likely be necessary. Remarks: Imazapic has mixed selectivity and some soil residual activity. It tends to favor members of the Asteraceae and some grasses. Use a methylated seed oil surfactant at 0.25%. Not registered for use in California.
Imazapyr <i>Arsenal, Habitat, Stalker,</i>	Rate: 1 to 1.5 pt product/acre (4 to 6 oz a.e./acre)

Chopper, Polaris	<p>Timing: Postemergence at flowering.</p> <p>Remarks: Imazapyr has a long residual activity and leaves more bare ground than other treatments, even a year after application. It is nonselective.</p>
Other products	<p>Quinclorac (<i>Paramount</i>) is extremely selective from 8 to 16 oz product/acre applied in spring at flowering. <i>Overdrive</i> in combination with the low rate of quinclorac is also effective.</p>

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Taeniatherum caput-medusae (L.) Nevski
(= *Elymus caput-medusae* L. [Jepson Manual 2012])

Medusahead

Family: Poaceae

Range: Arizona, California, Idaho, Nebraska, Nevada, Oregon, Utah, Washington; a few locations in the northeastern states.

Habitat: Disturbed sites, grassland, rangeland, openings in chaparral, oak woodlands, and rarely in agronomic fields. Generally in areas that receive at least 9 inches of rain per year, so not common in the low desert. Grows best on clay soils or where deep soil moisture is available late in the growing season.

Origin: Native to the Mediterranean region.

Impact: Dense stands displace desirable vegetation and reduce livestock and wildlife carrying capacity.

Unpalatable to livestock except during the early growth stages. The stiff awns and hard florets can injure eyes, nostrils, and mouths of grazing animals. Birds and rodents usually avoid feeding on the seeds. Senesced plants form a dense layer of thatch that takes a couple of years to decompose. The thatch layer changes the temperature and moisture dynamics of the soil, reduces seed germination of other species, and creates fuel for wildfires.

Western states listed as Noxious Weed: California, Colorado, Nevada, Oregon, Utah
California Invasive Plant Council (Cal-IPC) Inventory: High Invasiveness



Medusahead is a noxious rangeland weed that is increasing its range in most of the western states. It is an ascending to erect winter annual grass to 2 ft tall, producing spikes of long-awned spikelets. Medusahead matures at least 2 to 4 weeks later in the season than most other annual grasses, and from a distance, the yellowish-green sheen of dense stands is highly visible after other annual grasses turn brown. The mature plant has slender stems, and the leaf surfaces are glabrous or covered with soft, short hairs, and often appear glassy under magnification. Medusahead produces fibrous roots that grow throughout the cool season, depleting upper soil moisture early in the growing season and accessing deep soil moisture later on.

Medusahead flowers in early summer, often after other annual plants have senesced. Its spikes are 0.5 to 2 inches long excluding awns, and the main spike axis does not break apart at maturity. The fertile seeds have long, often twisted, awns 1 to 3 inches long; the seeds and awns are covered with minute, upward-pointing barbs and are rough to the touch. Seed production is usually prolific. Some florets (seeds) can remain attached to spikes long after plants turn brown. This characteristic allows seeds to disperse by clinging to the feet, fur, and feathers of animals and the shoes and clothing of people.

Most seeds germinate in fall after the first rain, but some seeds remain dormant or germinate in winter or spring. Seeds can germinate in dense litter under low moisture conditions. Seedlings remain attached to the long-awned floret. Seedlings can survive desiccation of the primary root and develop adventitious roots when moisture becomes available. Most seed appears to germinate or lose viability within 2 years in the field.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	There are mixed reports on the effectiveness of mowing. Early-season mowing is likely to be ineffective and may harm other species. Late-season mowing, at the boot to early flowering stage, may help to suppress medusahead. However, mowing after seed set will disperse the seeds. In areas where medusahead has built up a heavy thatch, removal of the thatch by raking, tillage, or burning
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	<p>can reduce dominance by medusahead and can help other plant species to get established.</p> <p>Tillage (disking and plowing) will control existing medusahead plants, as well as burying seed and breaking up deep thatch layers. Tillage should be accomplished before seed set. In rangeland or wildland areas, the increased potential for soil erosion, loss of soil moisture, loss of organic matter, and loss of macrobiotic crusts may outweigh the weed control benefits of tillage. These factors should be considered before applying tillage over a large area.</p>
Cultural	<p>The use of fire has given mixed results for medusahead control. Burning in low-elevation, warm-winter sites (e.g., California's Central Valley and foothills) can be extremely effective. Burns are conducted when medusahead is beginning to head out but before seed drop, when most desirable plants have already dropped seed. Two years of burning can nearly eliminate an infestation. In contrast, burning in high-elevation, cool-winter sites usually fails to control medusahead. It is thought that because of reduced ecosystem productivity and a shorter growing season at these sites, there isn't adequate fuel to carry a fire hot enough to kill medusahead seeds.</p> <p>Because of its high silica content, livestock generally avoid grazing medusahead as it approaches maturity. However, heavy grazing in spring, when medusahead is still palatable, can reduce, but not eliminate, an infestation. To limit seed dispersal, animals should be removed before the plants mature. Spring grazing is especially effective in areas where dried medusahead litter has been previously burned or grazed. Best control is achieved if plants are grazed in the stage of boot to flowerhead emergence. In experimental trials, medusahead populations have been reduced using confined grazing with sheep. In recent trials, fertilizing pastures with nitrogen improved the palatability of medusahead, making it attractive to cattle and resulting in medusahead suppression.</p> <p>As discussed above, thatch removal by raking, tillage, or burning can favor establishment of desirable plants. This can also improve efficacy of subsequent applications of some soil-applied herbicides, particularly imazapic.</p>
Biological	<p>Crown rot fungus (<i>Fusarium culmorum</i>), an endemic fungus of dry soils in the western states, is a potential biocontrol agent. However, there are no studies to show its effectiveness.</p>

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
Aminopyralid <i>Milestone</i>	<p>Rate: 7 to 14 oz product/acre (1.75 to 3.5 oz a.e./acre)</p> <p>Timing: Preemergence in fall.</p> <p>Remarks: A broadleaf-selective herbicide that is safe on most grasses. There is a 2(ee) Supplemental label for this use in Arizona, California, Colorado, Idaho, Oregon, Washington, Wyoming, and Utah. Research in California's Central Valley showed that 14 oz of <i>Milestone</i> (spot treatment rate)/acre gave ~90% control of medusahead, and 7 oz/acre gave ~60% control.</p>
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II, and others</i>	<p>Rate: 0.75 to 1 pt product (<i>Roundup ProMax</i>)/acre (0.42 to 0.56 lb a.e./acre) for early-season selective control in shrubland or other perennial systems; 1 to 2 qt product (<i>Roundup ProMax</i>)/acre (1.1 to 2.25 lb a.e./acre) for late-season, nonselective control.</p> <p>Timing: For selective control, apply postemergence in spring after all seedlings are up and before heading; the tillering stage is ideal. For late-season, nonselective control, apply to rapidly growing plants before seeds are produced.</p> <p>Remarks: Glyphosate is a nonselective herbicide with no soil activity.</p>
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Imazapic <i>Plateau</i>	<p>Rate: 4 to 12 oz product/acre (1 to 3 oz a.e./acre)</p> <p>Timing: Fall or spring. In warm-winter areas, fall applications may be most effective. In colder climates, spring applications after snow melt are better.</p> <p>Remarks: Imazapic has some soil residual activity and mixed selectivity. It tends to favor members of the</p>

	Asteraceae and some grasses. Use a spray adjuvant for postemergence applications. Effects vary depending on soil texture and soil organic matter. Heavy soils and high organic matter may require higher rates. Imazapic also can tie up in litter, and its efficacy is reduced under situations where there is lots of thatch on the soil surface. Not registered for use in California.
Rimsulfuron <i>Matrix</i>	Rate: 4 oz product/acre (1 oz a.i./acre) Timing: Preemergence (fall) to early postemergence (early spring). Remarks: Rimsulfuron controls several annual grasses and broadleaves. Perennial grasses are tolerant to fall applications when established and grown under dryland conditions. Application to rapidly growing or irrigated perennial grasses may result in their injury or death. It provides soil residual control in cool climates but degrades rapidly under warm conditions. Rimsulfuron will not control summer annual weeds when applied in fall or spring. Add a surfactant when applying postemergence.
Sulfometuron <i>Oust and others</i>	Rate: 0.75 to 1.5 oz product/acre (0.56 to 1.13 oz a.i./acre) Timing: Preemergence to early postemergence. Preemergence (fall) applications are generally more effective. Remarks: Sulfometuron is a broad-spectrum herbicide that is fairly safe on native perennial grasses. This can be an advantage in revegetation use. Use lower rates in arid environments, higher rates in wetter areas (> 20 inches rainfall) and on high organic matter soils. It has fairly long soil residual activity.
Sulfometuron + chlorsulfuron <i>Landmark XP</i>	Rate: 1.5 to 2.25 oz product/acre Timing: Preemergence, in fall or after soil thaws in spring. Remarks: See sulfometuron.

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center (wric.ucdavis.edu) or retail through the Western Society of Weed Science (wsweedscience.org) or the California Invasive Species Council (cal-ipc.org).

Lepidium latifolium L.

Perennial pepperweed (tall whitetop)



Family: Brassicaceae

Range: All western states, except North and South Dakota.

Habitat: Many different areas and habitats, including wetlands, riparian areas, meadows, vernal pools, salt marshes, flood plains, sand dunes, roadsides, irrigation ditches, ornamental plantings, and agronomic crops, including alfalfa, orchards, vineyards, and irrigated pastures. Most typically found on moist or seasonally wet sites in the west, and most problematic in riparian or wetland areas. Tolerates saline and alkaline conditions.

Origin: Native to Eurasia.

Impacts: Perennial pepperweed can rapidly form large, dense stands that displace desirable vegetation and wildlife. Populations easily spread along waterways and can infest entire stream corridors, riparian areas, or irrigation structures. Roots do not hold soil together well, allowing erosion of river, stream, or ditch banks. Flooded streams often wash away roots growing along the streambank, and new infestations develop downstream. Once established, perennial pepperweed is persistent and difficult to control in crops, natural areas, and ornamental plantings. Perennial pepperweed reduces forage quality in hay and pasture. Perennial pepperweed plants extract salts from deep soil and deposit them on the soil surface, inhibiting the germination and growth of other species that are sensitive to salinity.

Western states listed as Noxious Weed: California, Colorado, Idaho, Montana, New Mexico, Oregon, South Dakota, Utah, Washington, Wyoming

California Invasive Plant Council (Cal-IPC) Inventory: High Invasiveness

Perennial pepperweed is an erect perennial to 6 ft tall. The crown and lower stems are weakly woody. The foliage lacks hairs and is green to gray-green, often dusted with powdery white caused by a rust fungus. The basal leaves are larger and wider than stem leaves, to 1 ft long and 4 inches wide, with serrate margins. The aboveground parts typically die in late fall and winter, leaving dead stems and thatch which can persist for several years. The roots are long, thick, minimally branched, and vigorously creeping. Most grow in the top 2 ft of soil, but some can penetrate to a depth of 10 ft or more.

The inflorescences are rounded to pyramidal and consist of numerous small white flowers. The flowers have four petals, producing small pods (about 2 mm long) with tiny reddish-brown seeds (about 1 mm long). Perennial pepperweed is a prolific seed producer. Laboratory tests suggest seeds germinate readily with fluctuating temperatures and adequate moisture; however, seeds do not appear to remain viable in the soil for extended periods. As a result, perennial pepperweed reproduces primarily vegetatively from roots and root fragments. Large root fragments can survive desiccation on the soil surface for extended periods, and fragments as small as 0.5 to 1 inch long and 2 to 8 mm in diameter can develop into new plants. Root fragments and seeds disperse with flooding, soil movement, and human and animal activities.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	Seedlings are easily controlled by hand-pulling or tillage, but these techniques do not control established plants because shoots quickly resprout from vast root reserves. In addition, seedlings are not often encountered. Root segments as small as 1 inch are capable of producing new shoots. Cultivation and tillage typically increase infestations by dispersing root fragments. Clean equipment after tillage to prevent spreading root fragments.
	Mowing stimulates perennial pepperweed plants to resprout and produce new growth, but mowing is

	helpful for removing accumulated thatch. Mowing breaks old stems into small fragments and helps prevent shading of favorable species. Combining mowing with herbicides has been shown to be an effective control strategy. For best results, mow plants at the bolting or flower bud stage and apply herbicides to resprouting shoots once they have reached the flower bud stage.
Cultural	<p>Cattle, sheep, and goats will graze perennial pepperweed, especially rosettes in early spring. When stands are dense it becomes difficult for most animals to graze. Goats appear to tolerate heavy consumption of fresh plants. Sheep and goats permanently maintained in a pasture suppress growth of perennial pepperweed. However, once livestock are removed, plants quickly resprout.</p> <p>Burning is not effective at reducing perennial pepperweed stands, but it is helpful at removing accumulated thatch. Perennial pepperweed thatch burns best in winter or spring under dry conditions before initiation of spring growth.</p> <p>Seasonal flooding for an extended period during the growing season can significantly reduce populations. It is not known how long perennial roots can survive flooded conditions, but anecdotal information indicates that 6 months of submergence are required.</p> <p>Establishing desirable vegetation in disturbed areas can suppress perennial pepperweed and slow reinvasion after control. Because perennial pepperweed is very competitive, seed or transplant desirable vegetation after dense perennial pepperweed stands are controlled. Choose vigorous, fast-growing plant species that are adapted to the site. Perennial grasses are a good choice for natural areas and pastures. Grasses are tolerant of broadleaf-selective herbicides, and over time grasses form a thick sod that prevents future weed establishment. In pastures, promote grass expansion and vigor with fertilization and grazing management.</p>
Biological	Biological control agents are being evaluated for use on perennial pepperweed in the United States, but currently no organisms are available.

CHEMICAL CONTROL

The following specific use information is based on reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D	Rate: 2 qt product/acre (1.9 lb a.e./acre)
Several names	Timing: Postemergence at rosette to flowering stages. Most effective at flower bud or flowering stage. Remarks: 2,4-D often requires annual application for multiple years. It is broadleaf-selective and safe on most grasses. 2,4-D has minimal soil activity. Do not apply ester formulations when outside temperatures exceed 80°F. Amine forms are as effective as ester forms, and amine forms reduce the chance of off-target movement.
AROMATIC AMINO ACID INHIBITORS	
Glyphosate	Rate: 2 to 4 qt product (<i>Roundup ProMax</i>)/acre (2.25 to 4.5 lb a.e./acre). Spot treatment: 2 % product v/v
<i>Roundup, Accord XRT II, and others</i>	Timing: Postemergence from seedling to bloom stage. Most effective at flower bud or flowering stage. Remarks: Glyphosate will not kill seeds or inhibit germination the following season. Glyphosate is nonselective and has no soil activity. It can create bare ground conditions that are susceptible to weed recruitment. In areas with desirable vegetation, use spot treatment. Glyphosate is a good control option if reseeding is planned shortly after application, as it will not injure seedlings emerging after application. Add a surfactant when using a formulation where it is not already included (e.g., <i>Rodeo, Aquamaster</i>).
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron	Rate: 1 to 2.6 oz product/acre (0.75 to 1.95 oz a.i./acre)
<i>Telar</i>	Timing: Postemergence from seedling to flowering stage. Most effective at flower bud or flowering stage. Remarks: Chlorsulfuron has long soil residual activity. It has mixed selectivity, but is generally safe on grasses. Always use a surfactant. 2,4-D at 1 to 2 pt/acre can be tank-mixed with chlorsulfuron for

	quicker burndown. <i>Telar</i> can be used near water, but cannot be applied to water. Chlorsulfuron is included with aminocyclopyrachlor in <i>Perspective</i> . This combination (i.e., formulation) is expected to provide good control, but has not been reported.
Imazapic <i>Plateau</i>	<p>Rate: 8 to 12 oz product/acre (2 to 3 oz a.e./acre)</p> <p>Timing: Postemergence from seedling to flowering stage. Most effective from the bud to the late flowering stage.</p> <p>Remarks: Imazapic gives effective control with some soil residual activity. It can be used in combination with glyphosate (premix trade name of <i>Journey</i>). Selective to most native grasses. Higher rates may suppress seedings of some cool-season grasses. Add a methylated seed oil. Imazapic is not registered for use in California.</p>
Imazapyr <i>Habitat</i>	<p>Rate: 1 to 2 qt product/acre (0.5 to 1 lb a.e./acre)</p> <p>Timing: Postemergence from seedling to flowering stage. Most effective from the bud to the late flowering stage.</p> <p>Remarks: <i>Habitat</i> is registered for aquatic use. Also effective following early season mowing and/or disking. It is nonselective, has long soil residual activity, and leaves more bare ground than other treatments, even a year after application. Add a spray adjuvant.</p>
Metsulfuron <i>Escort</i>	<p>Rate: 1 to 2 oz product/acre (0.6 to 1.2 oz a.i./acre)</p> <p>Timing: Postemergence from seedling to flowering stage. Most effective at flower bud and flowering stage.</p> <p>Remarks: Metsulfuron has similar activity compared to chlorsulfuron. Metsulfuron has some soil residual activity. Always use a surfactant. Metsulfuron can be tank-mixed with 2,4-D for quicker burndown. Other premix formulations of metsulfuron can be used at similar application timing. These include <i>Cimarron Max</i> (metsulfuron + dicamba + 2,4-D) and <i>Cimarron X-tra</i> (metsulfuron + chlorsulfuron). Metsulfuron is not registered for use in California.</p>
Propoxycarbazone-sodium <i>Canter R+P</i>	<p>Rate: 0.9 to 1.2 oz product/acre (0.63 to 0.84 oz a.i./acre)</p> <p>Timing: Postemergence to young, rapidly growing plants.</p> <p>Remarks: Propoxycarbazone is a broad-spectrum herbicide that will control many species. It will provide only partial control of perennial pepperweed. Perennial grass species vary in tolerance. A non-ionic surfactant should be added at 0.25 to 0.5% v/v solution.</p>

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Conium maculatum L.

Poison-hemlock

Family: Apiaceae

Range: Throughout the contiguous U.S., including every western state.

Habitat: Moist soil along hedgerows, along the banks of streams and rivers, roadsides and wastelands, woodlands, meadows, and pastures.

Origin: Native to Europe.

Impact: Produces piperidine alkaloids which are highly toxic to humans and animals. Domestic animals such as swine, cattle, goats, horses, and sheep can be poisoned by the toxin coniine after ingesting any portion of the plant.

Poison-hemlock is the most toxic to cattle. Symptoms can include vomiting, nausea, trembling, rapid respiration, joint and movement problems, slow, weak and rapid pulse, increased salivation and urination, convulsions, paralysis, coma, and death from respiratory paralysis. Ingestion during fetal development can result in severe birth defects.

States listed as Noxious Weed: Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington

California Invasive Plant Council (Cal-IPC) Inventory: Moderate Invasiveness



Poison-hemlock is a tall branching biennial to 4 to 6 ft tall. The stem is erect, hollow, smooth, bright green with a distinctive mottled appearance and irregular purple splotches. The long-stalked leaves are glabrous, up to 2 ft long, bright green, alternate, and tripinnately compound (divided into leaflets which are again divided and subdivided). Its root is a long, forked, fleshy taproot, pale yellow in color, with numerous lateral roots.

The inflorescence is a compound umbel with 12 to 16 rays, and numerous small white flowers located at the terminal positions. Each flower produces two gray-brown seeds with five wavy longitudinal ridges. The seeds have the highest concentration of coniine. Poison hemlock smells like mouse urine when crushed, a characteristic of the poisonous alkaloids. Plants reproduce only by seed. Most seeds fall near the parent plant. Seed dispersal is prolonged and occurs from late summer through winter. Most seeds germinate almost immediately if conditions are favorable, but a small proportion remains dormant. Dormant seeds require a period of high summer and/or low winter temperatures before they can germinate. Seeds survive up to about 3 years under field conditions.

NON-CHEMICAL CONTROL

Mechanical (mowing, plowing, and cultivation)	Hand removal is recommended for small infestations. When pulling the plants, dig down and remove the entire taproot. Wear gloves and wash hands after working with poison-hemlock. Manual control efforts can be successful, but can cause soil disturbance encouraging further germination of seeds. Solid carpets of hemlock seedlings are not uncommon following soil disturbance. Cutting is ineffective; the plants send up new seed stalks in the same season the cutting occurs. Establishment of populations can be prevented with repeated cultivation and plowing.
Cultural	Due to the plant's toxicity, grazing is not recommended for control. Even dried plant parts are not safe as the toxins take several years to dissipate. Use certified weed-free hay to prevent the poisoning of livestock. Do not burn, as toxins can be released into the air through the smoke.
Biological	There are no known biological controls. Since its introduction to North America, only a few native insects have been able to overcome its toxic defenses. These attack the seedhead, but do very little damage to the rest of the plant.

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D Several names	Rate: 1 to 4 pt product/acre (0.48 to 1.9 lb a.e./acre) Timing: Postemergence in seedling to rosette stage. Remarks: Broadleaf-selective, most effective when applied soon after plants emerge. Adding a wetting agent may enhance control. Also effective tank mixed with dicamba.
Aminocyclopyrachlor + chlorsulfuron <i>Perspective</i>	Rate: 4.75 to 8 oz product/acre Timing: Postemergence in seedling to rosette stage. Remarks: Broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).
Aminopyralid + metsulfuron <i>Opensight</i>	Rate: 2.5 to 3.3 oz product/acre Timing: Preemergence in fall, or postemergence in the seedling to rosette stage. Remarks: Not registered for use in California.
Triclopyr <i>Garlon 4 Ultra, Remedy Ultra</i>	Rate: 5 to 8 pt product/acre (2.5 to 4 lb a.e./acre) Timing: Postemergence in seedling to rosette stage. Remarks: Broadleaf-selective, safe on most grasses. Most effective on smaller plants. <i>Garlon 4 Ultra</i> and <i>Remedy Ultra</i> are low volatile esters. However, in warm temperatures, spraying onto hard surfaces such as rocks or pavement can increase the risk of volatilization and off-target damage. Also effective in a premix with 2,4-D (<i>Crossbow</i>) or tank mixed with clopyralid (<i>Transline</i>).
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II, and others</i>	Rate: Broadcast treatment: 1.33 to 2.67 qt product (<i>Roundup ProMax</i>)/acre (1.5 to 3 lb a.e./acre). Spot treatment: 1 to 1.5% v/v solution Timing: Best when applied postemergence to rapidly growing plants before bolting. However, higher rates can control plants at the bud to full bloom stage. Remarks: Glyphosate is a nonselective herbicide that has no soil activity. Add a non-ionic surfactant.
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron <i>Telar</i>	Rate: 1 to 2.6 oz product/acre (0.75 to 1.95 oz a.i./acre) Timing: Postemergence to rapidly growing plants. Remarks: Desirable grasses should be well established before application.
Imazapic <i>Plateau</i>	Rate: 8 to 12 oz product/acre (2 to 3 oz a.e./acre) Timing: Preemergence. Remarks: Mixed selectivity, favors members of the Asteraceae and some grasses. Some soil residual activity. In postemergence applications, use methylated seed oil at 1.5 to 2 pt/acre. Not registered for use in California.
Imazapyr <i>Arsenal AC, Habitat, Stalker, Chopper, Polaris</i>	Rate: 2 pt product (<i>Arsenal AC</i>)/acre (1 lb a.e./acre); 4 pt product (<i>Habitat</i>)/acre (1 lb a.e./acre) + 1 qt/acre methylated seed oil Timing: Preemergence or early postemergence in the rosette stage. Remarks: Nonselective. Long soil residual, leaves more bare ground than other treatments, even a year after application. Do not apply more than 3 qt product/acre. <i>Habitat</i> is an aquatic registered formulation for use close to water.
Metsulfuron <i>Escort</i>	Rate: 1 oz product/acre (0.6 oz a.i./acre) Timing: Postemergence to rapidly growing plants. Remarks: Use a non-ionic surfactant or silicone surfactant. Prevent drift to sensitive plants. Apply only to pastures, rangeland, and non-crop sites. Metsulfuron can also be used in a premix with dicamba + 2,4-D (<i>Cimarron Max</i>). Metsulfuron and its formulations are not registered in California.

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.



University of Nevada
Cooperative Extension

Fact Sheet FS-03-34

(Updated 4/19/2011)

Identification and Management of Puncturevine *(Tribulus terrestris L.)*

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Puncturevine (*Tribulus terrestris* L., family Zygophyllaceae) is an annual noxious weed familiar to outdoor enthusiasts who have had unfortunate close encounters with this plant's thorny seeds. A native of Europe and Asia, puncturevine may have been introduced to the United States as a contaminant in the wool of sheep imported from the Mediterranean region. Also called goathead, bullhead, or Mexican sandbur, this weed grows rapidly along roads and waste places, leaving an ample seed bank to

ensure its spread. This weed is named on Nevada's noxious weed list.

Why should we be concerned?

The large, spiny seeds of the puncturevine plant can cause injury to the mouths and digestive tracts of livestock, and diminish the value of hay and wool. The weed contains a photosensitizing agent that poisons sheep when they eat flowering plants. Recreationists find the weed to be a nuisance, causing punctured bicycle tires



Puncturevine is a flat-growing, mat-forming, rapidly spreading weed.



Thorny seeds easily attach to car and bicycle tires, helping spread the weed along roadsides. The seeds are capable of puncturing bicycle tires.

and injuries to feet. Because it grows rapidly and produces seed quickly, infestations may increase greatly in size unless controlled or soil moisture becomes limited. The large mat-like infestations crowd out desirable plants.

What does puncturevine look like?

Puncturevine has a distinctive, low-growing, trailing, mat-like form. Its prostrate, green to reddish, hairy stems grow to 5 feet long and are highly branched, radiating from the crown of the plant. When shaded or competing with other plants, the stems may grow more erect and eventually trail over low-growing species, shading them out.

The plant is characterized by hairy leaves that are 1 inch to 2 inches long. Leaves are pinnately compound with three to seven leaflet pairs per leaf. Leaflets are tiny and oblong. Puncturevine has a somewhat woody taproot that can grow to 8.5 feet deep.

Bright yellow flowers are produced from late spring through early fall. The flowers have five petals and four sepals, and are pollinated by insects. A characteristic gray to yellowish-tan,

woody, 0.5-inch diameter burr then forms. It consists of five wedge-shaped nutlets, each of which has two stout spines. Three to five seeds are formed within each nutlet, and remain enclosed within the burrs. These burrs will often remain on the plant after it has been killed by frost, or are found on the soil surface after they break off or the plant dies and deteriorates.

Where does it grow?

Puncturevine is often found in croplands and



The leaves are composed of three to seven leaflet pairs, and the flowers are tiny and yellow, and have five petals.



Puncturevine burrs consist of five wedge-shaped nutlets containing three to five seeds each.

pastures, along roads, and in urban areas including alleys and vacant lots. It will grow in many types of soils, including compacted soil, sandy to clayey soils, dry or moist soils, and poor or rich soils. It grows best in areas where competition from other plants is limited. While it is widespread in the United States, the worst infestations are in the southwestern United States. The weed is common throughout Nevada.

How does it spread?

A summer annual, puncturevine reproduces by seed. The spiny nutlets adhere to tires, shoes, and clothing of people, as well as the fur, feathers and feet of animals, aiding its spread. The seeds appear to require a ripening period of about six months to one year, with germination occurring during spring and summer of the year after they were produced.

Germination requires warm temperatures and moisture. Seeds may germinate after any wet period during late spring and summer. Seeds may remain dormant during dry periods and are viable for four to five years. Plants grow rapidly, and flowers may be produced on new seedlings within three weeks, resulting in seed production as early as six weeks after germination. A plant may produce 200 to 5,000 seeds during one growing season, and a large plant may produce 10,000 or more seeds.

How is puncturevine controlled?

Long-term control of puncturevine relies upon the persistent elimination of seed stored in the soil. As with all annuals, mechanical controls are effective, although puncturevine's low-growing form makes mowing ineffective. On small infestations, hand-pulling is feasible, especially when soils are moist and the vines are sufficiently long to allow pulling. Hoeing and shallow cultivation are also effective at killing



Puncturevine infests a roadside in Yerington, August 2001.

existing plants, and should be initiated prior to flowering and seed production. Shallow tilling of one inch or less is sufficient, particularly when plants are small. Be aware, however, that tilling may bury seed that remains viable in the soil for several years.

In areas where many seeds have been deposited due to lack of control in previous years, it may be useful to attempt to harvest seeds by placing carpet or other "sticky" material on boards or a roller that are then applied to or rolled over the soil. With several passes, most of the seed on the soil can be removed. The seeds must be carefully contained, removed, and disposed of to prevent their spread. Application of 4 inches to 6 inches of organic mulch or synthetic light-excluding fabrics are also successful in controlling puncturevine.

Biological control of puncturevine has been successful in the past. There are two species of weevils that have been released in Nevada for control of puncturevine. The puncturevine seed weevil (*Microlarinus lareynii*) feeds upon developing seeds. This insect was introduced into Clark County in 1961. A second weevil, the puncturevine stem weevil (*Microlarinus lypriformis*), is an Italian weevil that mines the



These seeds have been damaged by seed-eating weevils.

stems and roots of the weed. It was released in 1963 in Lincoln County. Both insect species provide good control of puncturevine, although it can take several years to deplete the seed bank in the soil, and both species are sensitive to cold winter temperatures. Currently, populations of the insects are being moved to sites of serious infestation within Nevada.

For larger infestations, in areas with extensive seed banks, or where spot treatments are desired, it may be necessary to use herbicides to control puncturevine. When applied before seeds sprout, preemergence herbicides such as bromacil, chlorsulfuron, dichlobenil, imazapyr, oryzalin, oxyfluorfen, pendimethalin and trifluralin provide control of germinating seeds. Select sites carefully, however, as these products will control all germinating seeds, including desirable species. Certain herbicides such as chlorsulfuron may persist for more than one year, especially in alkaline soils.

A variety of herbicides are available for control of existing plants. Control is provided by post-emergent applications of 2,4-D (amine or LV

ester forms), dicamba, glyphosate, imazamox, imazethapyr, MCPA and MSMA. Follow label directions to determine rates and timing of application. Correct timing is essential for optimal control.

Special care must be taken when applying herbicides near or in streams, rivers, ponds, or lakes, or in areas with shallow water tables. Always read and follow label directions when applying pesticides.

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Brand names are provided for example purposes only. Other brands may also be licensed for use in Nevada. Information herein is offered with no discrimination. Listing a commercial product does not imply an endorsement by the authors, University of Nevada Cooperative Extension, or its personnel.

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Acroptilon repens (L.) DC.
(= *Centaurea repens* L.)

Russian knapweed

Family: Asteraceae

Range: All western and central states. Less common in eastern and southern United States.

Habitat: Fields, rangeland, cultivated sites, orchards, vineyards, roadsides, ditchbanks, and waste places. Grows on many soil types, but prefers sites that have moist soils such as drainages, riparian zones, river bottoms, irrigated fields, and runoff areas that are not excessively wet.

Once established, Russian knapweed is extremely drought tolerant and favors dry sites with full sun.

Origin: Native to central Asia.

Impacts: Russian knapweed is competitive and capable of forming dense monotypic stands. It also appears to have allelopathic properties. It has been shown that the plant can take up zinc from deep in the soil profile and deposit it on the soil surface to create a toxic environment. Russian knapweed can rapidly colonize disturbed areas. Populations are often extremely long-lived due to extensive root systems. Russian knapweed is toxic to horses, but livestock usually avoid grazing it because of its bitter taste.

Western states listed as Noxious Weed: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming
California Invasive Plant Council (Cal-IPC) Inventory: Moderate Invasiveness



Russian knapweed is a noxious perennial to 3 ft tall. The stems are erect, branched, leafy, and mostly covered with gray hairs. The leaves are alternate and do not extend down the stem as wings. Basal and lower stem leaves are mostly oblong, 2 to 5 inches long. Upper stem leaves are narrow, lanceolate to linear, 0.5 to 1.5 inches long. Old flower stems can persist for an extended period after senescence, eventually lodging and forming a significant thatch layer.

The flower heads are hemispheric, in panicle-like or flat-topped clusters. They consist of about 30 white, pink, or lavender-blue disk flowers interspersed with bristles on the receptacle. The flower heads remaining on old stems can aid in identification.

Russian knapweed roots can grow several feet deep, branching frequently to form an extensive vertical and horizontal root system. The plant reproduces primarily by vegetative shoots from creeping roots. Root fragments as small as 1 inch can develop into a new plant from depths to 6 inches. Russian knapweed also produces small quantities of viable seed, which fall near the parent plant or disperse with the seedheads. However, seedlings are uncommon. Seeds appear to survive 2 to 3 years under field conditions.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	Seedlings are easily controlled by hand-pulling or digging, but these techniques do not control established plants because shoots quickly resprout from vast root reserves. Multiple mowing passes during a season can suppress Russian knapweed, but mowing alone will not eliminate an infestation, and can even stimulate an increase in shoot density the following year. Removal of top vegetation stimulates shoot sprouting from roots. Cutting or mowing three times a year depletes nutrients in the roots, but unless mowing is continued, plants will recover. Mowing may not be possible in environmentally sensitive areas. Summer mowing followed by herbicide in fall can be effective. Root fragments resprout following tillage. Clean equipment after tillage to prevent spreading root
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	fragments. Repeated tillage to 1 ft deep over a period of about 3 years can kill much of the root system.
Cultural	<p>Livestock usually avoid grazing Russian knapweed because of its bitter taste. Russian knapweed is toxic to horses. Goats have been used to graze Russian knapweed.</p> <p>Burning is not effective at controlling Russian knapweed, but it is helpful at removing accumulated thatch. Thatch burns best in winter or spring under dry conditions before initiation of spring growth.</p> <p>Russian knapweed is sensitive to light competition, and crops that produce dense shade can be used to suppress it. Cultivation of dense competitive crops such as cereal grains, alfalfa, or perennial grasses can reduce Russian knapweed in crop fields. Reseeding with perennial grasses following control with herbicides can be effective at suppressing reinfestation in dryland areas.</p>
Biological	<i>Subanguina picridis</i> (Russian knapweed gall nematode) and <i>Aceria acroptiloni</i> (Russian knapweed mite) have been introduced and are established in several western states. These agents may help to stress the plant but will not eliminate it.

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
Aminocyclopyrachlor + chlorsulfuron <i>Perspective</i>	<p>Rate: 4.75 to 8 oz product (<i>Perspective</i>)/acre</p> <p>Timing: Postemergence, bud stage to senescence. Although above-ground stems die back in late summer and fall, the subsurface crown buds of Russian knapweed are highly susceptible to fall applications of this herbicide. Applications can be made into winter if conditions permit.</p> <p>Remarks: <i>Perspective</i> provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Aminocyclopyrachlor provides excellent control of Russian knapweed. It also gives soil residual control 1 year after application. Do not treat in the root zone of desirable trees and shrubs. Do not apply to frozen ground. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).</p>
Aminopyralid <i>Milestone</i>	<p>Rate: 3 to 7 oz product/acre (0.75 to 1.75 oz a.e./acre)</p> <p>Timing: Postemergence, bud stage to senescence. Although above-ground stems die back in late summer and fall, the subsurface crown buds of Russian knapweed are highly susceptible to fall applications of this herbicide. Applications can be made into winter if conditions permit.</p> <p>Remarks: Aminopyralid is one of the most effective herbicides for this weed. It is a broadleaf herbicide like picloram, but more selective. It also has a longer soil residual activity compared to clopyralid and can provide 2 years of control. Aminopyralid is safe on most grasses, although preemergence application at high rates can greatly suppress some annual grasses, such as medusahead. Applications can decrease seed production in some annual and perennial grass species. For postemergence applications, a non-ionic surfactant (0.25 to 0.5% v/v spray solution) enhances control under adverse environmental conditions; however, this is not normally necessary. Do not apply to frozen ground.</p> <p>Other premix formulations of aminopyralid can also be used. These include <i>Opensight</i> (aminopyralid + metsulfuron; 2.5 to 3.3 oz product/acre) and <i>Forefront HL</i> (aminopyralid + 2,4-D; 1.5 to 2.1 pt product/acre).</p>
Clopyralid <i>Transline</i>	<p>Rate: 0.67 to 1.33 pt product/acre (4 to 8 oz a.e./acre). Use higher rate for older plants or dense stands.</p> <p>Timing: Postemergence, bud stage to senescence. Although above-ground stems die back in late summer and fall, the subsurface crown buds of Russian knapweed are highly susceptible to fall applications of this herbicide. Applications can be made into winter if conditions permit.</p> <p>Remarks: Clopyralid has shorter soil residual activity compared to aminopyralid or aminocyclopyrachlor. It controls or injures plants in the Asteraceae and Fabaceae, but is safe on</p>

	most other broadleaf species and all grasses. For postemergence applications, addition of a non-ionic surfactant (0.25 to 0.5% v/v spray solution) enhances control under adverse environmental conditions; however, this is not normally necessary. Clopyralid can also be tanked mixed with aminopyralid (<i>Milestone</i>) for effective control. Do not apply to frozen ground.
Clopyralid + 2,4-D <i>Curtail</i>	Rate: 2 to 4 qt <i>Curtail</i> /acre Timing: Same as for clopyralid. Remarks: Add a non-ionic surfactant.
Picloram <i>Tordon 22K</i>	Rate: 1 qt product/acre (0.5 lb a.e./acre) Timing: Postemergence, bud stage to senescence. Although above-ground stems die back in late summer and fall, the subsurface crown buds of Russian knapweed are highly susceptible to fall applications of this herbicide. Applications can be made into winter if conditions permit. Remarks: Picloram controls a wide range of broadleaf species and has relatively long soil residual activity. Although well-developed grasses are not usually injured by labeled use rates, some applicators have noted that young grass seedlings with fewer than four leaves may be killed. Do not apply near trees, or where soil is highly permeable and where water table is high. Do not apply to frozen ground. Picloram is a restricted use herbicide. Picloram is not registered for use in California.
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II, and others</i>	Rate: 4 qt product (<i>Roundup ProMax</i>)/acre (4.5 lb a.e./acre). Spot treatment: 2% v/v solution. Timing: Postemergence to rapidly growing plants in the bud stage. Remarks: Glyphosate does not control Russian knapweed as well as some other products and will not kill seeds or inhibit germination the following season. Glyphosate has no soil activity and is nonselective. It can create bare ground conditions that are susceptible to weed recruitment. In areas with desirable vegetation, use spot treatment. Glyphosate is a good control option if reseeding is planned shortly after application, as it will not injure seedlings emerging after application. Add a surfactant when using a formulation where it is not already included (e.g., <i>Accord, Rodeo, Aquamaster</i>).
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron <i>Telar</i>	Rate: 1 to 2.6 oz product/acre (0.75 to 1.95 oz a.i./acre) Timing: Postemergence at flower bud to flowering stage, or fall rosette stage, or winter. Remarks: Always use a surfactant. Included with aminocyclopyrachlor in <i>Perspective</i> .
Imazapic <i>Plateau</i>	Rate: 12 oz product/acre (3 oz a.e./acre) Timing: Late postemergence in fall when the top 25% of the plant is necrotic, but before a hard frost. Application should be made when some green stem and foliage remains on plant. Timing should correspond to fall basal growth. Remarks: Some trials show this treatment to provide no or only partial control, but Russian knapweed is included on the <i>Plateau</i> label. Selective to most native grasses. Higher rates may suppress seedlings of some cool-season grasses. Add ammonium sulfate and a methylated seed oil. Imazapic is not registered for use in California.
Metsulfuron <i>Escort</i>	Rate: 1 to 2 oz product/acre (0.6 to 1.2 oz a.i./acre) Timing: Postemergence at flower bud to flowering stage or to fall rosettes. Remarks: Always use a surfactant. Other premix formulations of metsulfuron can be used at similar application timing. These include <i>Cimarron Max</i> (metsulfuron + dicamba + 2,4-D), <i>Opensight</i> (metsulfuron + aminopyralid), and <i>Cimarron X-tra</i> (metsulfuron + chlorsulfuron). Metsulfuron is not registered for use in California.

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

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Onopordum acanthium L.

Scotch thistle

Family: Asteraceae

Range: All western states.

Habitat: Disturbed areas such as river and stream corridors, roadsides, right-of-ways, trails, rangeland, pasture, forest clearings, and abandoned cropland. Best suited to areas with high soil moisture during germination periods. Often associated with degraded annual plant communities and areas with high rodent activity. Not common on annually cultivated lands.

Origin: Native to Eurasia.

Impacts: Scotch thistle populations spread rapidly and can form dense stands over large acreage. Seeds contain a water-soluble germination inhibitor causing a high percentage of seeds to remain dormant in the soil. This makes control difficult and a long-term commitment.

Populations often expand rapidly on infested land during wet years due to the large amount of seed that break dormancy. Sharp spines on leaves, stems, and seedheads deter livestock and wildlife from grazing. Dense stands create a natural barrier that prevents movement by livestock, wildlife, and humans.

Western states listed as Noxious Weed: Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming
California Invasive Plant Council (Cal-IPC) Inventory: High Invasiveness

Scotch thistle is a biennial with large, green, spiny leaves that are covered with fine, cottony hairs. Rosettes can often grow up to 1 to 2 ft in diameter and mature plants are generally 4 to 6 ft tall. Scotch thistle's tall, spiny stature made it useful as a natural fence in Europe centuries ago.

Flower heads are large (1 to 3 inches diameter), spherical to hemispherical, and either solitary or in clusters of 2 to 7. The heads consist of numerous spine-tipped phyllaries in many overlapping rows. The numerous disk flowers are purple (sometimes white) and showy. The pappus is composed of bristles (7 to 9 mm long) that form a detachable ring at the base. Scotch thistle reproduces only by seeds. It produces large numbers of achenes that remain viable in the soil for 7 to 39 years. Seeds contain a water-soluble germination inhibitor, and greater than 80% of the seeds display innate dormancy at maturity. Germination often occurs in spring and fall during saturated soil conditions. Seed dispersal is primarily by wind, but can also occur with water, rodents, livestock, or vehicles.

NON-CHEMICAL CONTROL

Mechanical
(pulling, cutting,
disking)

Small infestations can be removed by manual methods. Digging is effective and the preferred manual removal method. When digging, sever the root below the soil surface.

Mowing in the late bolting or bud stage can reduce seed production. Mow before flowering to prevent seeds from developing in severed flowerheads. On sites with high soil moisture, plants may need to be removed to prevent flowering on regrowth. When mowing is conducted too early, it only delays flowering. Similarly, when plants are cut too late in the flowering process, viable seed may still develop in the seedhead. Because there can be wide variation in plant maturity, a single mowing is unlikely to provide satisfactory control, but repeated mowing throughout the entire growing season can be successful. For



	total kill, plants must be cut off below the soil surface with no leaves remaining. Tillage will control emerged plants but often stimulates germination. Land managers using tillage for seedbed preparation for reseeding efforts should prepare for a flush of seedlings when soils become saturated.
Cultural	Sheep, goats and horses, but not cattle, have a significant effect on thistles in the early stages of infestation when they eat young thistle plants. Sheep may graze small rosettes. Goats ignored the leaves of Scotch thistle, but they ate all the flower heads and prevented seed production and dispersal. Cattle avoid grazing Scotch thistle. Overgrazing promotes Scotch thistle. Fire is not an effective control. Promoting competitive vegetation can slow spread and help prevent establishment. Perennial grass plantings have been shown to inhibit Scotch thistle seedling establishment and can reduce Scotch thistle populations. Perennial grass stand density and vigor should be managed to minimized bare ground exposure.
Biological	No biological controls are currently available in the United States. Australia has released biocontrol insects, but some of them have failed host specificity tests in the U.S. Insects are being evaluated by USDA for release in the U.S.

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D Several names	Rate: 1 to 2 qt product/acre (0.95 to 1.9 lb a.e./acre) Timing: Postemergence from rosette to beginning of bolting, or fall rosette. Most effective on small rosettes. Remarks: Often tank-mixed with chlorsulfuron or dicamba for quicker burndown. Does not control large bolting plants. Broadleaf-selective and safe on most grasses. 2,4-D has minimal soil activity. Do not apply ester formulation when outside temperatures exceed 80°F. Amine forms are as effective as ester forms for small rosettes, and amine forms reduce the chance of off-target movement.
Aminocyclopyrachlor + chlorsulfuron <i>Perspective</i>	Rate: 4.75 to 8 oz product (<i>Perspective</i>)/acre Timing: Postemergence and preemergence. Postemergence applications are most effective when applied to plants from the seedling to the bolting stage. Remarks: Aminocyclopyrachlor provides excellent control of Scotch thistle at most growth stages. One of the few herbicides that provides soil residual control 1 year after application. <i>Perspective</i> provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).
Aminopyralid <i>Milestone</i>	Rate: 5 to 7 ounces product/acre (1.25 to 1.75 oz a.e./acre) Timing: Postemergence from the rosette to young bolting stage. Remarks: Longer soil residual than clopyralid. Safe on most grasses, although preemergence application at high rates can greatly suppress some annual grasses, such as medusahead. Applications can decrease seed production in some annual and perennial grass species. Provides over 90% control when applied to rosettes. For postemergence applications, adding a non-ionic surfactant (0.25 to 0.5% v/v spray solution) enhances control under adverse environmental conditions; however, this is not normally necessary. Other premix formulations of aminopyralid can also be used for Scotch thistle control. These include <i>Opensight</i> (aminopyralid + metsulfuron; 1.5 to 2.5 oz product/acre) and <i>Forefront HL</i> (aminopyralid + 2,4-D; 1.5 to 2.1 pt product/acre); apply at the rosette to bolting stage.
Clopyralid <i>Transline</i>	Rate: 0.67 to 1.33 pt product/acre (4 to 8 oz a.e./acre). Use higher rate for older plants or dense stands.

	<p>Timing: Postemergence from the rosette to young bolting stage. Results are best if applied to rapidly growing weeds.</p> <p>Remarks: Most effective for young plants. Shorter soil residual than aminopyralid or aminocyclopyrachlor. Controls or injures plants in the Asteraceae and Fabaceae but safe on most other broadleaf species and all grasses. For postemergence applications, a non-ionic surfactant (0.25 to 0.5% v/v spray solution) enhances control under adverse environmental conditions; however, this is not normally necessary.</p>
Clopyralid + 2,4-D <i>Curtail</i>	<p>Rate: 2 to 4 qt <i>Curtail</i>/acre</p> <p>Timing: Same as for clopyralid.</p> <p>Remarks: Add a non-ionic surfactant.</p>
Dicamba <i>Banvel, Clarity</i>	<p>Rate: 0.5 to 2 pt product/acre (0.25 to 1 lb a.e./acre). Use higher rates for large rosettes and bolting plants.</p> <p>Timing: Postemergence from rosette to beginning of bolting, or fall rosette.</p> <p>Remarks: A broadleaf-selective herbicide often combined with other active ingredients. Not typically used alone to control Scotch thistle. Dicamba can also be mixed with 2,4-D (0.5 to 1 pt dicamba + 2 pt 2,4-D/acre) from rosette to bolting stage.</p>
Picloram <i>Tordon 22K</i>	<p>Rate: 0.5 to 0.75 pt product/acre (2 to 3 oz a.e./acre).</p> <p>Timing: Preemergence and postemergence. With postemergence application, best time is rosette to early bolting stage, when plants are growing rapidly.</p> <p>Remarks: Picloram controls a wide range of broadleaf species and has relatively long soil residual activity. Lower rates in rate range may require annual spot treatments. Although well-developed grasses are not usually injured by labeled use rates, some applicators have noted that young grass seedlings with fewer than four leaves may be killed. Picloram is a restricted use herbicide. Picloram is not registered for use in California. Do not apply near trees, or where soil is highly permeable and where water table is high.</p> <p>Control with lower rates may be improved by tank mixing with dicamba or 2,4-D: picloram + dicamba (0.25 to 0.5 pt picloram + 0.125 to 0.25 pt dicamba/acre), or picloram + 2,4-D (0.5 to 1 pt picloram + 1 to 2 pt 2,4-D/acre).</p>
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II, and others</i>	<p>Rate: 1 to 2 qt product (<i>Roundup ProMax</i>)/acre (1.1 to 2.25 lb a.e./acre). Spot treatment: 1.5% v/v solution.</p> <p>Timing: Postemergence to rapidly growing plants from the rosette to early bolting stage.</p> <p>Remarks: Glyphosate will only provide control in the year of application, and will not kill seeds or inhibit germination the following season. Glyphosate has no soil activity and is nonselective. It can create bare ground conditions that can make an area susceptible to weed recruitment. In areas with desirable vegetation, use spot treatment. Glyphosate is a good control option if reseeding is planned shortly after application, as it will not injure seedlings emerging after application. Add a surfactant when using a formulation where it is not already included (e.g., <i>Rodeo, Aquamaster</i>).</p>
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Chlorsulfuron <i>Telar</i>	<p>Rate: 1 to 2.6 oz product/acre (0.75 to 1.95 oz a.i./acre)</p> <p>Timing: Postemergence from the rosette to flower bud stage.</p> <p>Remarks: One of the more effective treatments for large bolting plants. Always use a surfactant. Can be tank-mixed with 2,4-D for quicker burndown.</p>
Metsulfuron <i>Escort</i>	<p>Rate: 1 to 2 oz product/acre (0.6 to 1.2 oz a.i./acre)</p> <p>Timing: Postemergence from the rosette up until flower-bud stage.</p> <p>Remarks: Similar activity compared to chlorsulfuron. Always use a surfactant. Metsulfuron can be tank-mixed with 2,4-D for quicker burndown. Other premix formulations of metsulfuron can be used at similar application timing. These include <i>Cimarron Max</i> (metsulfuron + dicamba + 2,4-D), <i>Opensight</i> (metsulfuron + aminopyralid), and <i>Cimarron X-tra</i> (metsulfuron + chlorsulfuron). Metsulfuron and premixes containing metsulfuron are not labeled for use in California.</p>

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Centaurea stoebe L. ssp. *micranthos* (Gugler) Hayek
(= *Centaurea biebersteinii* DC., *Centaurea maculosa* Lam.)

Spotted knapweed

Family: Asteraceae

Range: Most contiguous states except parts of the southeast.

Habitat: Fields, roadsides, disturbed open sites, grassland, rangeland, especially degraded rangeland, logged areas. Seldom persists in shaded places. Serious infestations often occur on light, well-drained soils in areas that receive some summer rainfall.

Origin: Europe, Asia Minor; introduced into the U.S. in the 1890s.

Impact: Highly competitive with native vegetation. Forms dense stands that can exclude desirable vegetation and wildlife in natural areas.

Western states listed as Noxious Weed: Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming

California Invasive Plant Council (Cal-IPC) Inventory: High Invasiveness



Spotted knapweed is a bushy biennial to short-lived perennial, to 3 ft tall, with a long, sturdy taproot. Plants form basal rosettes during winter and early spring (sometimes persisting as rosettes for several years) and develop erect, highly branched flowering stems in late spring and summer. Its alternate leaves are pinnate-lobed, dotted with resin ducts, and covered with short to medium interwoven grayish hairs.

The 30 to 40 disk flowers in each flowerhead are white, pink, or purple, and the phyllaries have comb-shaped, dark-colored tips which give the flowerheads a "spotted" appearance. After the flowerheads mature and dry out, they pop open, ejecting achenes near the parent plant. Achenes have a short (1 to 2 mm) bristly pappus on the top. Spotted knapweed can also reproduce vegetatively from lateral roots just below the soil surface. New rosettes may develop at about 3-cm intervals along lateral roots, expanding populations peripherally. Achenes can remain dormant in the soil for 8 years and have three germination patterns: non-dormant seeds that germinate with or without light exposure, dormant seeds that germinate in response to light, and dormant seeds that are not light sensitive. All germination types occur on each plant. Spotted knapweed has been shown to occasionally hybridize with diffuse knapweed.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)

Hand pulling is feasible for scattered spotted knapweed plants, or for areas where other control methods are not feasible and sufficient labor is available. Generally, this form of control is limited to small infested areas. Repeated hand pulling is necessary during the season and over many years. Successful control has been reported when plants were hand removed 3 times a year (spring, summer, and late summer) over a period of 5 years. Every effort should be made to remove the entire taproot with little soil disturbance. If not possible, then cut the root 2 to 4 inches below the soil surface to remove much of the reproductive crown. Gloves should be worn when hand pulling. The best timing for hand removal is before plant produce viable seed. Hand pulling has not been effective in all areas. When soil dries, it may be difficult to remove the root crown and this can lead to rapid reestablishment.

Manual control methods may pose less risk to high quality waters and high value fisheries than do chemical applications. Although time- and labor-intensive, several manual control methods, including propane torching of seedlings early in the season, hand digging with small tools, mulching with black plastic, and mowing with weed eaters have proven successful for smaller populations.

Mowing typically doesn't kill knapweeds; cut plants generally survive and recover to set seed. Plants

	<p>mowed at the rosette stage will quickly recover, and mowing too late (after seed set) can disperse seed. However, mowing at the late bud to early bloom stage will reduce seed production. Mowing can also remove dead growth to improve herbicide coverage. A program of cutting only bolted plants, particularly in the early bloom stage, 2 to 4 times per year for several consecutive years can greatly suppress spotted knapweed and may shift the competitive balance in favor of desired grasses. Mowing is not possible in areas that are too rocky or steep, or with desirable shrub species.</p> <p>Spotted knapweed does not persist under annual cultivation, which is why it is not typically a cropland weed. However, tillage in wildland or rangelands can spread spotted knapweed, because tillage creates an ideal weed seed bed.</p>
Cultural	<p>Maintaining pasture and rangeland health by preventing overgrazing and minimizing disturbance can help limit knapweed establishment and spread.</p> <p>Grazing is not considered to be an effective eradication method. In addition, intensive grazing can create ideal seedbeds for further invasion. However, researchers have shown that cattle, sheep and goats will readily graze spotted knapweed in early spring, suppressing seed production. Sheep are the most effective. Sheep typically graze spotted knapweed from the rosette through bud stage or when it is the only plant available. The timing of grazing may be critical to its success. Early and late-season grazing appear to be the most effective control timings with sheep: early season (spring) to reduce flower production, and late season (fall) to reduce density of young plants. In one study, two consecutive years of early and late sheep grazing prevented spotted knapweed seed production, and the sheep were healthy. In addition, this grazing program had little effect on the native grass community.</p> <p>There is little information on the use of prescribed burning for control of spotted knapweed. On the one hand, burning has been shown to control diffuse knapweed while stimulating grass regrowth, and under the right conditions perhaps the same response might occur with spotted knapweed. On the other hand, spotted knapweed can be the first species to recover from a burn. A low-severity fire is not likely to kill the below-ground reproductive structures of spotted knapweed, but a severe fire may kill some of the plant crowns. Burning removes current growth but may enhance seed germination. Dry soil conditions at the time of burning can reduce germination. Another potential benefit of burning is that it can remove dead growth to improve the effect of herbicide applications.</p>
Biological	<p>Currently, there is no single biological control agent that effectively controls spotted knapweed populations. The banded gall fly (<i>Urophora affinis</i>), knapweed seedhead fly (<i>U. quadrifasciata</i>), lesser knapweed flower weevil (<i>Larinus minutus</i>), broad-nosed seedhead weevil (<i>Bangasternus fausti</i>) are established in the United States to date. The hairy weevil (<i>Eustenopus villosus</i>) that primarily attacks yellow starthistle has also been reported on spotted knapweed. These insects cause plants to produce fewer viable seeds and to abort flowers. <i>Larinus minutus</i> in particular is an aggressive and effective biocontrol insect for diffuse and spotted knapweed. Its larvae may destroy up to 100% of the seeds in an infested seedhead. Larvae pupate in the seedhead; the adults emerge and consume the foliage until they enter the litter and soil to overwinter.</p> <p>Three moth species (<i>Agapeta zoegana</i>, <i>Pelochrista medullana</i>, and <i>Pterolonche inspersa</i>) and a weevil (<i>Cyphocleonus achates</i>) that feed on spotted knapweed roots have also been released. Root-feeding insects may have a more detrimental effect on knapweed populations than seed-feeding ones. It is hoped that the collective stress on the plant caused by these insects will reduce seed production and lead to decreased competitiveness.</p>

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

GROWTH REGULATORS	
2,4-D	Rate: 1 to 2 qt product/acre (0.95 to 1.9 lb a.e./acre)
Several names	Timing: Postemergence from rosette to beginning of bolting, or fall rosette. Optimal at early flowering stage.
	Remarks: Control with 2,4-D is only temporary and does not prevent seedling establishment the following year. Generally requires repeat applications. 2,4-D is not considered as effective as other growth regulator herbicides for season-long control. Broadleaf-selective and may injure other non-

	target species, particularly crop plants. 2,4-D has no soil activity. Do not apply ester formulation when outside temperatures exceed 80°F. Amine forms are as effective as ester forms at the small rosette stage, and amine forms reduce the chance of off-target movement.
Aminocyclopyrachlor + chlorsulfuron <i>Perspective</i>	<p>Rate: 4.75 to 8 oz product (<i>Perspective</i>)/acre</p> <p>Timing: Postemergence and preemergence. Postemergence applications are most effective when applied to plants from the seedling to the mid-rosette stage.</p> <p>Remarks: Aminocyclopyrachlor gives control of spotted knapweed similar to aminopyralid. <i>Perspective</i> provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).</p>
Aminopyralid <i>Milestone</i>	<p>Rate: 5 to 7 oz product/acre (1.25 to 1.75 oz a.e./acre)</p> <p>Timing: Postemergence and preemergence. Postemergence applications are most effective when applied to plants from the rosette to the bolting stage. Effective control can also be obtained with a fall application to new regrowth.</p> <p>Remarks: Aminopyralid is one of the most effective herbicides for the control of spotted knapweed. It is safe on grasses, although preemergence application at high rates can greatly suppress invasive annual grasses, such as medusahead. Aminopyralid has a longer residual and higher activity than clopyralid. Other members of the Asteraceae and Fabaceae are very sensitive to aminopyralid. For postemergence applications, a non-ionic surfactant (0.25 to 0.5% v/v spray solution) enhances control under adverse environmental conditions; however, this is not normally necessary.</p> <p>Other premix formulations of aminopyralid can also be used for spotted knapweed control. These include <i>Opsight</i> (aminopyralid + metsulfuron; 1.5 to 2 oz product/acre) and <i>Forefront HL</i> (aminopyralid + 2,4-D; 2 to 2.6 pt product/acre), both applied at the rosette to bolting stages.</p>
Clopyralid <i>Transline</i>	<p>Rate: 0.67 to 1.33 pt product/acre (4 to 8 oz a.e./acre). Use higher rate for older plants or dense stands.</p> <p>Timing: Applied preemergence to seedlings or postemergence to seedlings or mature plants, but generally optimal to apply postemergence in spring, at beginning of bolting up to the bud stage. Can also apply to fall regrowth. Results are best if applied to rapidly growing weeds.</p> <p>Remarks: While clopyralid is very safe on grasses, it will injure many members of the Asteraceae, particularly thistles, and can also injure legumes, including clovers. Most other broadleaf species and all grasses are not injured.</p>
Clopyralid + 2,4-D <i>Curtail</i>	<p>Rate: 2 to 4 qt <i>Curtail</i>/acre</p> <p>Timing: Same as for clopyralid</p> <p>Remarks: The addition of 2,4-D can increase the damage to other non-target broadleaf species. Add a non-ionic surfactant.</p>
Dicamba <i>Banvel, Clarity</i>	<p>Rate: 1 to 2 pt product/acre (0.5 to 1 lb a.e./acre). Use higher rate for older plants or dense stands.</p> <p>Timing: Postemergence from rosette to beginning of bolting, or fall rosette. Optimal at early flowering stage.</p> <p>Remarks: Dicamba is a broadleaf-selective herbicide often combined with other active ingredients. It is not typically used alone to control spotted knapweed. Dicamba can also be mixed with 2,4-D (1 pt dicamba + 2 pt 2,4-D/acre) or picloram (1 to 2 pt dicamba + 0.5 to 1 pt picloram/acre) for spot treatments.</p> <p>Dicamba is available mixed with diflufenzopyr in a formulation called <i>Overdrive</i>. This has been reported to be effective on spotted knapweed. Diflufenzopyr is an auxin transport inhibitor which causes dicamba to accumulate in shoot and root meristems, increasing its activity. <i>Overdrive</i> is applied postemergence to rapidly growing plants at 4 to 8 oz product/acre. Higher rates should be used on large annuals and biennials or when treating perennial weeds. Add a non-ionic surfactant to the treatment solution at 0.25% v/v or a methylated seed oil at 1% v/v solution.</p>
Picloram	<p>Rate: 1 to 2 pt product/acre (4 to 8 oz a.e./acre). Use higher rates for older plants or dense stands.</p> <p>Timing: Postemergence and preemergence. Postemergence applications are best at rosette to mid-</p>

Tordon 22K	<p>bolting stage (before flowering to prevent current year seed production), or fall rosette stage. Apply when plants are growing rapidly. Under favorable growing conditions, application in summer can be effective if higher application volumes are used.</p> <p>Remarks: Picloram is a broadleaf herbicide. It gives a broader spectrum of control than aminopyralid, aminocyclopyrachlor, and clopyralid, and has a much longer soil residual. Lower rates may require annual spot treatments. Treatment made in bud stage may not prevent seed production in the year of application. Picloram has been shown to provide selective control of spotted knapweed for 3 to 4 years. Although well-developed grasses are not usually injured by labeled use rates, some applicators have noted that young grass seedlings with fewer than four leaves may be killed. Do not apply near trees. Picloram is a restricted use herbicide. It is not registered for use in California.</p> <p>Control with lower rates may be improved by tank mixing with dicamba or 2,4-D; picloram and dicamba (0.25 to 0.5 pt/acre + 0.125 to 0.25 pt/acre) and picloram plus 2,4-D (0.5 to 1 pt picloram + 1 to 2 pt 2,4-D/acre). A backpack sprayer or a wiper is recommended in small areas to minimize damage to non-target plants.</p>
AROMATIC AMINO ACID INHIBITORS	
Glyphosate <i>Roundup, Accord XRT II,</i> and others	<p>Rate: Broadcast foliar treatment: 3 qt product (<i>Roundup ProMax</i>)/acre (3.375 lb a.e./acre). Spot treatment 1.5% v/v solution</p> <p>Timing: Postemergence to rapidly growing knapweed when most plants are at bud stage.</p> <p>Remarks: Glyphosate will only provide control during the year of application; it has no soil activity and will not kill seeds or inhibit germination the following season. Glyphosate is nonselective. To achieve selectivity, it can be applied using a wiper or spot treatment to control current year's plants.</p>

RECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center (wric.ucdavis.edu) or retail through the Western Society of Weed Science (wsweedscience.org) or the California Invasive Species Council (cal-ipc.org).

Ventenata dubia (Leers) Coss. & Dur.

North African wiregrass

Family: Poaceae

Range: Many western states, particularly the northwestern states including Washington, Oregon, California, Idaho, Montana, Wyoming, and Utah.

Habitat: Bunchgrass, sagebrush, and meadow communities. Also found in Conservation Reserve Program lands, pastures and grass hayfields.

Origin: Native to Eurasia and North Africa.

Impacts: *Ventenata dubia* can outcompete perennial bunchgrasses but the mechanism for this ability is not clear. It is high in silica (2.7%)—making it poorly palatable to grazing animals—but not as high as medusahead (6.4%). Litter can build up on the soil surface, likely because of the higher silica content. Plants dry early in the season, similar to downy brome, and should pose similar risks with respect to fire.



North African wiregrass is a short-statured winter annual grass, 6 to 28 inches tall, with narrow leaves 1 to 2 mm wide. It is shallowly rooted, typically within the top 1 to 2 inches of soil. Ligules are membranous and 1 to 4 mm long.

The spikelets resemble a small wild oat. Spikelets usually have 3 florets with at least 1 floret with a twisted awn, 3/4 to 1 inch long that is attached to the lemma at 1/2 the lemma length. Seeds disperse primarily by falling to the ground soon after maturity. Seeds readily germinate in fall, approximately 2 weeks after downy brome emerges. Seed burial studies suggest longevity in the field of less than 2 years.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	Hand pulling when the soil is moist can uproot this shallowly rooted species. Small infestations of a few square yards potentially could be pulled, but this is too labor intensive with large infestations.
Cultural	Grazing for weed control is unlikely to be effective given the low palatability of North African wiregrass. Using grazing to maintain competitive perennial grasses should indirectly provide some suppression. Prescribed burning in summer would be expected to provide some control of <i>Ventenata dubia</i> , provided it was conducted while the seeds remained on the plant. There is no direct evidence to support this, but results with similar species suggest that it would likely be effective.
Biological	There are no biological control efforts for the management of <i>Ventenata dubia</i> .

CHEMICAL CONTROL

The following specific use information is based on reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

AROMATIC AMINO ACID INHIBITORS

Glyphosate	Rate: 0.75 pt product (<i>Roundup ProMax</i>)/acre (0.42 lb a.e./acre)
<i>Roundup</i> , <i>Accord XRT II</i> , and others	Timing: Postemergence. Fall application is the best timing to kill plants and prevent injury to many natives. Spring application will reduce seed production.
	Remarks: Glyphosate at this low rate can be effective in fall and prevent long-lasting injury to perennial bunchgrasses. Multiple years of treatment are necessary. The herbicide is nonselective and has no soil activity.

BRANCHED-CHAIN AMINO ACID INHIBITORS	
Imazapic <i>Plateau</i>	<p>Rate: 5 to 6 oz product/acre (1.25 to 1.5 oz a.e./acre)</p> <p>Timing: Postemergence to seedlings in early spring or fall.</p> <p>Remarks: If warm-season perennial grasses are present, apply in fall when they are dormant and annual grasses have germinated. This timing will damage cool-season perennial grasses. If applied in pasture and desirable grasses are injured, a half rate of a balanced fertilizer applied the following spring may facilitate recovery. Imazapic has some soil residual activity. Imazapic is not registered for use in California.</p>
Rimsulfuron <i>Matrix</i>	<p>Rate: 4 oz product/acre (1 oz a.i./acre)</p> <p>Timing: Preemergence or postemergence in fall.</p> <p>Remarks: Rimsulfuron controls several annual grasses and broadleaves. Perennial grasses are tolerant to fall applications when established and grown under dryland conditions. Application to rapidly growing or irrigated perennial grasses may result in their injury or death. It provides soil residual control in cool climates but degrades rapidly under warm conditions. Rimsulfuron will not control summer annual weeds when applied in fall or spring. Add a surfactant when applying postemergence.</p>
Sulfometuron <i>Oust and others</i>	<p>Rate: 0.75 to 2.25 oz product/acre (0.56 to 1.7 oz a.i./acre)</p> <p>Timing: Either preemergence or postemergence in fall or early spring.</p> <p>Remarks: Sulfometuron is a broad-spectrum herbicide and will control many species. A combination of sulfometuron and chlorsulfuron (<i>Landmark XP</i>) at 0.75 oz product/acre has also been shown to be very effective.</p>
Sulfosulfuron <i>Outrider</i>	<p>Rate: 0.75 oz product/acre (0.56 oz a.i./acre)</p> <p>Timing: Either preemergence or postemergence in fall.</p> <p>Remarks: If meadow foxtail is present, it will be removed with this application. Planting of some wheatgrasses is possible in the following spring but other species should not be planted until the following fall or spring.</p>
PHOTOSYNTHETIC INHIBITORS	
Hexazinone <i>Velpar L</i>	<p>Rate: 2 to 6 qt product/acre (1 to 3 lb a.i./acre), check hexazinone formulation to make sure active ingredient rate is correct</p> <p>Timing: Preemergence in fall or very early spring.</p> <p>Remarks: There is no direct evidence that hexazinone will control <i>Ventenata dubia</i>, but it is generally effective against annual grasses and would be expected to be effective. High rates of hexazinone can create bare ground, so only use high rates in spot treatments.</p>

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