
NORTH RIM LANDSCAPE COORDINATED WEED MANAGEMENT AREA PLAN



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Prepared by:

The Uncompahgre Partnership

In partnership with the:

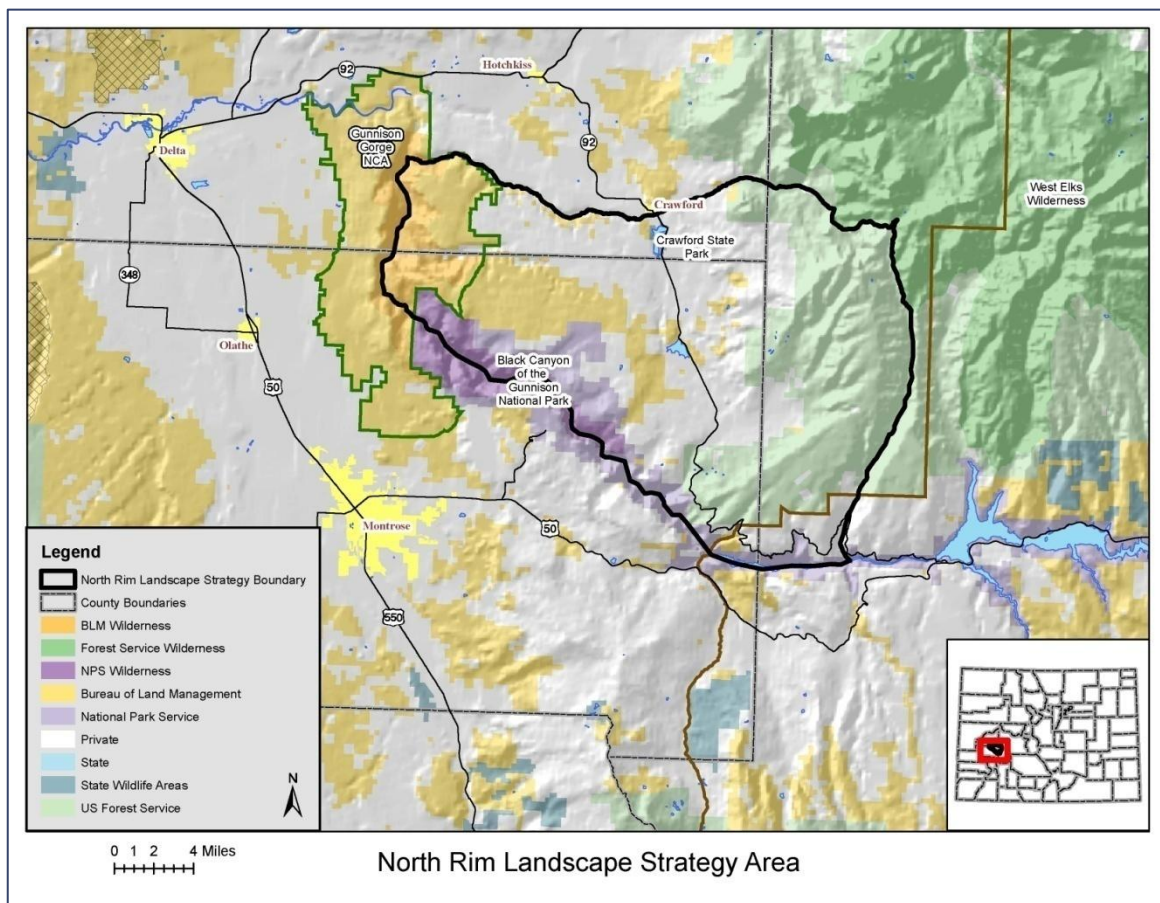
Bureau of Land Management, US Forest Service, National Park Service, Counties of Delta, Montrose and Gunnison, and Natural Resources Conservation Service.

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I. INTRODUCTION

Located in southwestern Colorado, the North Rim Landscape (NRL) Weed Management Area (WMA) encompasses 345 square miles or approximately 220,000 acres of land, with a mixed ownership pattern represented by Bureau of Land Management (BLM), National Park Service (NPS), US Forest Service (USFS), State, and private lands. The North Rim area derives its name from the north rim of the Black Canyon of the Gunnison National Park and includes portions of the Gunnison Gorge National Conservation Area and the Gunnison National Forest. The NRL is divided among three counties: Delta, Montrose, and Gunnison and is near the communities of Crawford, Hotchkiss, Montrose, Olathe, and Delta. The unincorporated community of Maher is located along Colorado Highway 92 inside the WMA.



The NRL WMA Partners include:

- Montrose County
- Delta County
- Gunnison County
- Bureau of Land Management – Uncompahgre Field Office
- US Forest Service – Grand Mesa, Gunnison and Uncompahgre National Forests
- Colorado State University Extension
- Natural Resources Conservation Service
- Private Landowners
- Grazing Permittees
- North Rim Landscape Strategy Working Group
- The Uncompahgre Partnership (UP)

The North Rim Landscape, like many areas in the western United States, is feeling the strain of sustaining varied multiple uses. The area contains vital habitat for active Gunnison sage-grouse populations, abundant elk herds, and numerous other wildlife. Public lands are used for cattle grazing, hunting and recreation. Recreational use in the area is increasing, creating more unauthorized roads and trails that fragment habitat. The majority of the private land is populated at a low density and under agricultural production, but county and regional trends suggest the potential for increases in human development in the future. As human activities increase, conflicts will occur. Specific threats to the area include a loss of wildlife habitat; degradation of the natural vegetation with spread of invasive species; and increased fragmentation of habitat and natural processes, including fire, and soil erosion.

Recognizing the need for a coordinated landscape-scale vision for the area, the North Rim Landscape Management Strategy Workgroup came together to formulate interagency and interdisciplinary strategies based on best available data, local knowledge, and workgroup members' expertise. The strategic plan calls for developing a Coordinated Weed Management Plan. See the strategic

plan at: www.northrimlandscapestrategy.org. The Uncompahgre Partnership (UP), a local non-profit collaborative, was awarded a National Fish and Wildlife Foundation "Pulling Together" Grant and is developing a Coordinated Weed Management Plan for this landscape. Unc/Com, Inc. serves as the 501-c-3 fiscal agent of the UP.

Land Status	
Bureau of Land Management	44,136 acres
US Forest Service	70,617 acres
National Park Service (NPS) – Black Canyon of the Gunnison National Park	18,160 acres
National Park Service (NPS) – Curecanti National Recreation Area	6,980 acres
Colorado State Lands - Crawford State Park	747 acres
Private Lands	79,444 acres

The majority of the WMA, 140,000 acres or 64%, is in federal ownership administered by: BLM - Uncompahgre Field Office; US Forest Service, Gunnison National Forest – Paonia Ranger District; National Park Service – Black Canyon National Park and Curecanti National Recreation Area. The NRL WMA partners include the: Bureau of Land Management, US Forest Service, National Park Service, Counties of Delta, Montrose and Gunnison, Colorado Division of Wildlife, National Resources Conservation Service, North Rim Landscape Strategy Working Group members, private landowners and grazing permittees.

This collaborative partnership is attempting to understand the impacts of human activity on the landscape and focus on ecosystem restoration in a manner that involves and best serves the interests of the local communities. Invasive species are a major non-native intrusion that prevents effective land restoration. The vision for the collaborative is to control and suppress the invasive species populations that are currently established, as well as prevent new infestations.

II. PURPOSE OF THE WMA PLAN

The North Rim Landscape Strategic Plan called for the development of a Coordinated Weed Management Plan and treatment program understanding the long-term impacts that invasive species will have on the ecosystem. The grant money received from the National Fish and Wildlife Foundation “Pulling Together” Grant has been used to develop a Coordinated Weed Management Area Plan and Treatment Program for the WMA. Because of the varied land status of the WMA, it was agreed that a collaborative effort of all partners was needed in order to accomplish an effective and efficient multi-year program.

The establishment of the WMA enhances and unites the partners for the development of a weed management program. The partners collaboratively established the goals, objectives, and priorities for treatment in the WMA. The partners are committed to helping each other accomplish a Coordinated Weed Management Area Plan using Integrated Weed Management techniques.

Integrated Weed Management (IWM) is a systems approach to the management of undesirable plants. It involves the use of the best control techniques described for the target weed species in a planned, coordinated program to limit the impact and spread of the invasive species. An IWM (as defined in the Federal Noxious Weed Act) is:

“A system for the planning and implementation of a program, using an interdisciplinary approach, to select a method for containing or controlling an undesirable plant species or group of species using all available methods including: education, prevention, physical or mechanical methods, biological control agents, herbicide methods, cultural methods and general land management practices”.

The value of using an IWM approach in a WMA is a more efficient and effective use of limited resources by creating one weed management plan that focuses time, money and resources toward agreed upon priorities. By pooling resources available from the different partners in the group and eliminating political boundaries, we hope to prevent, contain, reduce, suppress, or eradicate invasive species in the WMA.

Weed infestations are widespread and affect many aspects of our lives. Weeds can drastically alter the ecological checks and balances that have developed over thousands of years. Cheatgrass has so altered the fire regime of the Great Basin that re-establishing native plant communities in some areas is essentially impossible (Mosely et al. 1999). Cheatgrass is an annual that quickly develops an extensive fibrous root system, which removes moisture from the soil that is critical for the growth of native plants. One study of spotted knapweed showed that runoff increased by 56% on areas infested by spotted knapweed and that sediment yield increased by 192% (Lacey et al. 1989). A Montana study showed a 98% decrease in elk use of a bunchgrass range and a 67% decline in

carrying capacity after spotted knapweed infestation (Hakim 1979). It is estimated that Russian knapweed has pushed out native plant species on more than a million acres of land in the United States (Whitson 1999). Some non-native species release substances in the soil that prevent re-establishment of native species. For example, tamarisk can increase the salinity of soils to the point that native willows and cottonwoods can no longer grow.

Numerous invasive species presently not found in this WMA, are within striking distance. Many of the activities planned in the WMA will provide an opportunity for the introduction of new invasive species. A typical occurrence will be along roads and waterways, in wetlands, soil disturbances, mining sites, areas affected by wildfire, areas affected by resource management activities, residences, feeding areas for livestock, cultivated fields, previous farmlands that are not being correctly managed, recreation trailheads, and areas impacted by improper grazing resulting in the decline of the healthy vegetation. It will take the eyes and energy of everyone to find and stop the spread of weeds. Many studies have documented the rate of spread to be 8 – 12 % per year for most invasive species. This translates to hundreds of acres per year being infested annually with invasive species.

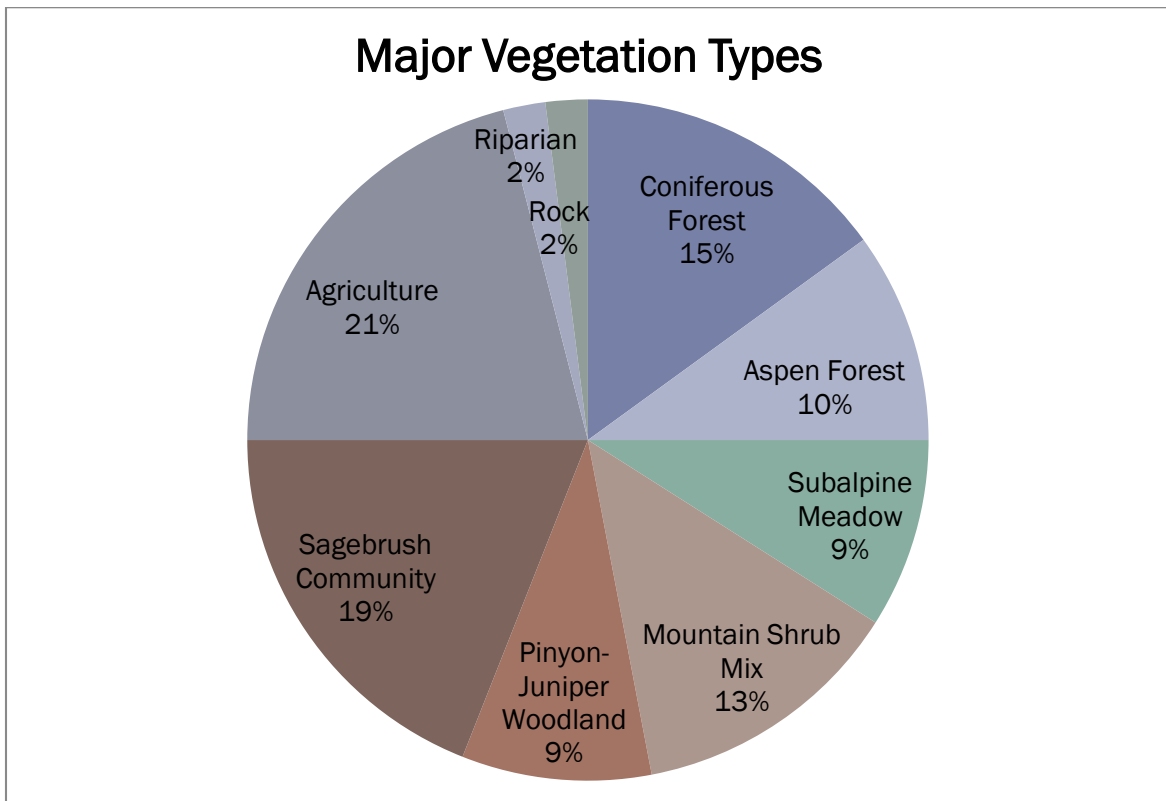
III. GOALS FOR THE NRL WMA

1. Restore the species and age diversity and quality/productivity of existing plant and animal communities by removing or preventing invasive species establishment.
2. To facilitate a better understanding of the social and economic impacts of noxious weed invasion to the users, community leaders, landowners, developers, and resource managers.
3. Develop and instill the understanding that Weed Prevention Best Management Practices need to be part of everyone's daily land ethic.
4. Retain a healthy landscape that provides the goods and services that benefit our communities today and in the future.
5. Increase and expand community, landowner and inter-agency involvement, education and collaboration regarding invasive species management.
6. Be a good neighbor and participate in accomplishing the objectives of the NRL Weed Management Plan.

IV. NORTH RIM LANDSCAPE WEED MANAGEMENT AREA DESCRIPTION

Beginning at the confluence of Curecanti Creek and the Gunnison River, the WMA follows the river for 45 miles, down-stream, through the Curecanti National Recreation Area (NRA), the Black Canyon of the Gunnison National Park, the Gunnison Gorge Wilderness and the Gunnison Gorge National Conservation Area (GGNCA). The river serves as the southern and western boundary of the NRL area. The northern boundary follows up the Smith Fork main drainage east the Gunnison National Forest boundary and then turns southeast along the hydrologic divide (Saddle Mountain, Bald Mountain) to the West Elk Wilderness boundary above Bald Mtn. Reservoir. The boundary then follows the West Elk Wilderness boundary to Curecanti Creek and then down Curecanti Creek for 20 miles back to the Gunnison River.

All the watersheds in this WMA drain into the Gunnison River. The major tributaries that drain this landscape are Curecanti, Crystal and Smith Fork drainages. The lowest elevation (5,154 ft) is at the confluence of Smith Fork Creek and the Gunnison River at the northwest corner of the WMA. The highest elevation is 11,843 feet on Bald Mountain at the top of the Crystal Creek watershed at the USFS Wilderness Boundary. The vegetation correlates with the elevation. Mixed conifer forests are located at the higher elevations with aspen and ponderosa pine forests giving way to pinyon-juniper forests, mountain shrub communities, sagebrush communities, grasslands and riparian forests along the streams and rivers.



The North Rim Landscape Strategy Working Group developed a Strategic Plan in order to collaboratively develop broad recommendations for the management of the area while operating under an adaptive management strategy that allows for revisions based on new information. The document serves as a guide for land management agency administrators, resource professionals, county planners, local private land owners and the interested public for both short and long-term planning at the landscape scale and as a resource in future site-specific project planning. These recommendations were made to help resolve several issues on the larger landscape including a decline in overall ecosystem health and natural functions, impacts from current recreational use and the potential for increased use in the future, and potential threat to the health of native wildlife species (especially Gunnison sage grouse). In many areas, the woody vegetation has matured to decadent late succession overstory communities that are impacting carrying capacity for ungulates and effecting fire behavior. This results in wildlife issues for a small Gunnison Sage Grouse population that is struggling to remain viable, burgeoning elk population and their distribution that is impacting private lands. Increase of human development and recreational uses brings with them invasive species ready to spread into any land disturbing activities.

The North Rim area has been identified as important Gunnison Sage Grouse habitat due to the small, marginally viable, population, limited habitat suitability, particularly specific seasonal habitats, and listing as a candidate species under the Endangered Species Act. This particular subpopulation is one of only a few remaining subpopulations and as such has great value for its genetic diversity. Most of the BLM lands within the area are part of the Gunnison Sage Grouse Area of Critical Environmental Concern (ACEC). The Gunnison Sage Grouse Conservation Plan for the Crawford area states that habitat quality and quantity are one of the major factors that drive Sage Grouse population.

The North Rim area has also been identified as an important year around elk and deer habitat. Due to the inter mixture of private lands the deer and elk spend significant time on private lands, leading to conflicts with agricultural producers and other landowners in the area. The winter elk use also has impacts on grouse habitats, particularly on leks, which are key locations essential for the long-term survival of this subpopulation.

Land Health Assessments (LHAs) for the 44,000 BLM acres across this landscape were completed in 2001. The assessment indicates heightened risk of erosion, lack of perennial grasses, and forbs, extensive invasions by non-native species, scattered noxious weed infestations, low shrub vigor in some areas as well as problems with vegetation age-class diversity and desired landscape mosaics. Recommendations in the LHA to alleviate some of the issues include utilizing a combination of mechanical treatments, invasive species control and fire followed by seeding with native species.

Recreation is the principal use of public lands in the NRL area. In particular, the Gunnison Gorge National Conservation Area, Gunnison Gorge Wilderness, Black Canyon of the Gunnison National Park, Black Canyon Wilderness Area, West Elk Wilderness Area and Crawford State Park are

destinations for a variety of recreationists and are recognized for their outstanding scenic values and recreational opportunities, including Gold Medal trout fishery. One of the unique uses to this area is shed antler collecting in the spring on big game winter ranges.

Livestock grazing is the most common annual activity and has taken place on this WMA continually for the last 130 years. The higher elevations are seasonally grazed from June to October, while the lower elevations and some private lands have livestock present all year. The BLM has 9 allotments (7 cattle, 1 sheep/cattle and 1 sheep), with 2,661 cattle AUM's within the WMA. The Forest Service has 4 allotments, 18 permittees, and 11,935 AUM's. The grazing practices have changed over the years to promote healthy, vigorous plant communities, but past improper grazing has caused the most significant decline in healthy rangelands over the years. Vegetative conditions on the Gunnison National Forest in the WMA are currently healthy and in satisfactory condition.

Water rights to divert and store water for irrigation and livestock are an important part of the farming and ranching industry. The main agriculture crops grown include alfalfa, grass hay and small grains. The two major vectors for the spread of weeds are by mechanized vehicles along travel routes and water distribution systems carrying seeds. Major water ways include the Gunnison River, Crystal Creek, Smith Fork of the Gunnison River, Curecanti Creek, Crawford Reservoir and Gould Reservoir. Several perennial and intermittent streams and ephemeral drainages as well as numerous ditches (predominately on private lands) also exist in the NRLS area. Surface water is used for irrigation as well as by livestock and wildlife.

The WMA contains a high density of all types of public roads. Colorado Highway 92 bisects the area and is listed as a Scenic Byway in Colorado. In addition, a network of major and minor roads have been created by land management agencies, counties, hunters, loggers, ranchers, motorized recreationists and others. Other major roads include: C-77 Rd., Crystal Creek Rd., Black Canyon Rd., Clear Fork Rd., B-76 Rd., Poison Springs Rd., Fruitland Mesa Rd., D-77 Rd., D-00 Rd. and A-75 Rd. The increase of traffic counts over the last 5 years has shown a 20 to 30% increase in traffic volume for all levels of roads. This trend will continue as local population numbers and recreation uses increase. These activities bring an increase in road improvement needs and utility corridors leading to more ground disturbance. These ground disturbances lead to the spread of invasive species infestations. The road base material used on many of the county roads has also been a source of weed seeds and has helped the spread of non-native species.

Wildfires occurring in this WMA have generally been mixed in severity. Many times, fires start as a ground fire fed by dried cheatgrass in more open areas and then increase in intensity where shrub and tree stands exist. Fires typically are short in duration and last for only a few days. Lightening causes the majority of the fires. If invasive species exist in the area, fire creates the opportunity for the spread of weeds.

This area supports an undetermined variety of wildlife species. Some species are year-round residents, while others are migratory. Habitat variety is great and is created by diversity in topography, slope, aspect, vegetation, soils, and climate. Prominent wildlife species in this area include mule deer, elk, mountain lion, coyote, prairie dog (whitetailed), raptor and a wide variety of other aquatic, reptile, avian, and small mammal species. Wildlife species that are of concern at the federal or state level would be Gunnison sage grouse and the river otter in the Gunnison River. Wildlife surveys and biological opinions are required each time management practices are proposed on public lands to mitigate any impacts to these species. The WMA is in Game Units 53 and 63. The WMA is both summer and critical winter range for big game. Plant communities that provide winter browse plants are aging, resulting in fewer, older browse plants and less forage production. This trend has been addressed by resetting succession to earlier serial stages in some areas of the WMA by land managers through active treatments. Although these treatments are successful in improving the carrying capacity of the rangeland, preventing the invasion of invasive species has become a major concern.

V. OBJECTIVES FOR THE NRL WMA

The following objectives will be completed by the UP under the direction of the WMA Partners.

- **Inventory / Survey** will be completed from existing databases of the federal land managers, prior knowledge of weed infestations, and field reconnaissance starting 2010 and continuing in 2011. The data will be maintained in a GIS format under NRL WMA.
- **High Priority Areas to Inventory** for the WMA would be Sage Grouse key habitat, roadways, trailheads, livestock concentration areas, water distribution systems, gravel pits, etc.

Advantages of knowing invasive species populations:

- Develop strategy to focus on prevention and early detection, rather on control and containment
 - Predict potential problems and likely sites of invasion
 - Strategically spend resources to get the most cost/benefit
 - Leverage funding
 - Provide knowledge for restoration projects
- **Mapping** will be completed for known invasive species in the WMA. High priority areas will be overlaid with known invasive species infestations to help focus management attention.
 - **Coordinated Weed Management Plan** will be completed for the NRL WMA by 5/20/2011 that sets the priority and strategy by species.
 - **Communications:** will include several contacts with the WMA Partners during the development of the CWMA Plan. The outreach plan may include: public meetings; letters to landowners and permittees; presentations to special interest groups, water distribution companies, Sage Grouse Working Group, County Weed Boards, etc. All material will be put on the UP and NRLS web site.
 - **Weed Prevention Best Management Practices** will be developed as part of the Weed Management Plan and used for outreach efforts.
 - **Annual Operating Plan** will be developed for implementing the CWMP. This will begin in 2011.
 - **Private Land Cost-Share Program.** Work with irrigation distribution system companies to control the spread of weeds, utilizing a challenge cost-share approach.

- **Reporting** of accomplishments by WMA partners will be reviewed each year at the fall meeting scheduled by the UP. The partners will use the developed spreadsheet to report annual treatments.
- **Monitoring** of the treatment activities and invasive species infestations will be facilitated by the partners periodically and used to improve or make changes in the Integrated Management Plan strategy. Monitoring techniques are described in the appendix. How do identify and monitor high-risk areas (human, animal, corridors, disturbed areas)?
- **Program Effectiveness** (treatment, prevention, early detection) will be evaluated each year by the core team with changes or modifications to the Annual Operating Plan made by 3/1 of the next year.

VI. WEEDS OF CONCERN IN THE NRL WMA

The State of Colorado defines a noxious weed as a non-native species to the state that meets one or more of the following criteria:

- (a) Aggressively invades or is detrimental to economic crops or native plant communities;
- (b) Is poisonous to livestock;
- (c) Is a carrier of detrimental insects, diseases or parasites; or
- (d) The direct or indirect effect of the presence of this plant is detrimental to the environmentally sound management of natural or agricultural ecosystems.

The State of Colorado has classified noxious weeds into three prioritized categories or lists (List A, B and C).

List A Species

List A noxious weeds have minimal distributions or have not yet been detected within the state. They have demonstrated an ability to spread rapidly or cause significant harm. Eradication is the mandatory management objective.

List B Species

List B noxious weed species have varying distribution within the state and are subject to eradication, containment or suppression. The development and implementation of noxious weed management plans designed to stop the continued spread of these species is mandated. If possible, eradication of the species is most desirable.

List C Species

List C noxious weed species are the lowest priority because their populations are widespread throughout the state. If possible, suppression of the species is most desirable.

The major invasive species found in the NRLS area include: whitetop (*Lepidium draba*) –State List B; Russian knapweed (*Centaurea repens*) –State List B; spotted knapweed (*Centaurea maculosa*) –State List B; yellow toadflax (*Linaria vulgaris*) –State List B; cheatgrass (*Bromus tectorum*) –State List C; jointed goatgrass (*Aegilops cylindrica*) –State List B; bull thistle (*Cirsium vulgare*) –State List C; musk thistle (*Cardus nutans*) –State List C; and Canada thistle (*Cirsium arvense*) –State List C. Yellow star thistle (*Centaurea solstitialis*) –State List A; oxeye daisy (*Leucanthemum vulgare*) –State List B; houndstongue (*Cynoglossum officinale*) –State List B; and leafy spurge (*Euphorbia esula*) –State List A are known to occur in the region but are not yet been mapped in the NRLS area. Spotted knapweed is considered the species of greatest priority for eradication in this area as it is still an isolated occurrence.

Because of limited resources, the NRL WMA Partners have prioritized the invasive species known to occur in the area. Treatment strategies will be targeted at high priority species before other priority species.

1. 2011 List of High Priority Invasive Species within the WMA

- Yellow starthistle (*Centaurea solstitialis*). CO State List A
- Sulfur cinquefoil (*Potentilla recta*). CO State List B
- Leafy spurge (*Euphorbia esula*). CO State List B
- Yellow toadflax (*Linaria vulgaris*). CO State List B
- Oxeye daisy (*Chrysanthemum leucanthemum*). CO State List B
- Spotted knapweed (*Centaurea maculosa*). CO State List B

2. 2011 List of Other Priority Invasive Species within the WMA

- Russian knapweed (*Acroptilon repens*). CO State List B
- Whitetop or Hoary cress (*Cardaria draba*). CO State List B
- Musk thistle (*Carduus nutans*). CO State List B
- Bull thistle (*Cirsium vulgare*). CO State List B
- Canada thistle (*Cirsium arvense*). CO State List B
- Houndstongue (*Cynoglossum officinale*). CO State List B
- Jointed goatgrass (*Aegilops cylindrica*). CO State List B
- Common burdock (*Arctium minus*). CO State List C
- Cheatgrass (*Bromus tectorum*). CO State List C

3. 2011 Early Detection/Reward Species

- Yellow star thistle
- Sulfur cinquefoil
- Leafy spurge
- Yellow toadflax

VII. INTEGRATED WEED MANAGEMENT TECHNIQUES (IWM):

The partners have organized the invasive species present in the WMA into three priority categories in Section V and agreed upon the “Priorities for Weed Management” in Section VIII. With the inventories of these invasive species and knowledge of the effective weed management strategies for the individual species, one can determine the general management control objective of eradication, suppression or containment. Because prevention measures will be the most cost effective and ecologically sound techniques to employ, the top three priorities are prevention techniques. The following five priorities are active management strategies to control the spread of invasive species. Within each of these five priorities, specific Integrated Weed Management Techniques were developed for known species infestations.

An integrated weed management approach attempts to focus on using multiple techniques to control the spread of invasive species and, therefore, in the long run will lead to greater success compared to simply focusing on controlling weeds without a special strategy. (See Detailed IWM Techniques in Appendix D.) Small, isolated infestations are managed differently than large, dense infestations. Small infestations are defined as less than 1/10th of an acre and the IWM techniques are recommended in Priorities 5 and 7 of this Section. The large area infestations have been delineated and the IWM techniques for these infestations are recommended in Priorities 6 and 8 of this Section.

VIII. PRIORITIES FOR WEED MANAGEMENT

The following priorities were developed for the invasive species in the WMA because limited resources need to be focused on those weed species which have the greatest impact on our well being and those which become more difficult to control if action is delayed. Weeds with a propensity to spread to other uninfected areas have been given a high priority for immediate treatment with the goal of containment.

Some landowners may have only one or two low priority noxious weed species on their property. In this case it may be feasible to control any and all the noxious weeds on the property. At the other extreme, weed infestations may be extensive on a property, prompting one to decide which weed species are most important to control. Anytime treatment is being accomplished for an area, all noxious weeds should be treated while you are at the site. In general, weed species that are rare on the WMA or have a small isolated infestation should be eradicated while large populations of common weed species should be contained with a long-term plan.

The priorities for the WMA are as follows:

1. Implement weed prevention Best Management Practices (BMPs)
2. Keep inventoried weed free areas – weed free
3. Implement early detection – rapid response
4. Eradicate or suppress invasive species along roadsides, ditches, gravel pits, utility ROW's, livestock concentration areas, and other high use or critical areas
5. Eradicate or suppress inventoried small, isolated infestations of High Priority species

6. Eradicate or suppress inventoried small, isolated infestations of Other Priority species
7. Manage large infestations of High Priority species by area
8. Manage large infestations of Other Priority species by area

Priority #1: Implement Weed Prevention Best Management Practices (BMP)

An outreach plan to educate users on BMPs will be developed. Representatives of the stakeholders will speak to user groups regarding the importance of weed infestation prevention. BMP flyers will be posted at major trailheads and other locations within the WMA, targeting the following groups. (See Appendix A for BMPs)

1. Public Land User Groups
2. Real Estate Industry
3. Utility / Energy Companies / Water Companies
4. Federal Resource Managers—All Levels
5. County Departments: Weed / Road / Planning
6. Public Land Permit and / or Easement Holders
7. Private Landowners

Priority # 2 Keep Inventoried Weed Free Areas – Weed Free

There are areas within the WMA that are not infested with invasive weeds. With the knowledge that prevention is the most cost effective strategy, these areas will be viewed as priority areas. Any weed infestations within these areas will be treated immediately.

General weed free areas will be delineated and mapped.

The following is a list of contact people. These individuals will confirm new infestations, record location (GIS) and submit information to the partners:

- Montrose County: Laurie Mingen (970) 249-5216
- Delta County: Web Callicut (970) 234-5096
- Gunnison County: Jon Mugglestone (970) 901-6018
- BLM: Lynae Rogers (970) 240-1068
- USFS: David Bradford(970) 527-4131
- UP Staff: Jim Free (970) 275-0752

Once a new infestation is located and confirmed, Rapid Response with an eradication objective will be implemented by: public land manager, private landowner, homeowner association, and/or county. All treatments will be reported to the UP by 11/20 of each year.

Priority #3 *Implement Early Detection – Rapid Response*

All new infestations of invasive species will be eradicated upon detection within the WMA. The strategy is to prevent new infestations from producing a seed crop and spreading.

- Responsibility for early detection of all invasive species will be assigned to the appropriate county, federal and/or state land management agency, permittee, landowner, user group, or contractor.
- The above is a list of contact people. New infestations will be confirmed, denote GIS location and submit information to the inventory data base.
- Once a new infestation is located and confirmed, rapid response with an eradication objective will be implemented by: public land manager, private landowner, homeowner association, and/or counties.
- The site will be monitored periodically.
- All treatments will be reported to the UP by 11/20 of each year.

Members of the public will receive a \$100 reward for the detection of new infestations of these invasive weeds.

- Yellow star thistle
- Sulfur cinquefoil
- Leafy spurge
- Yellow toadflax

Priority #4: *Eradicate or suppress invasive species along roadsides, ditches, gravel pits, utility ROW's, livestock concentration areas, high use or other critical areas.*

The WMA contains roads, resource management activities and special areas of concern. These areas have a high potential for the infestation and spread of noxious weeds. Land managers, ranchers, private landowners, outdoor enthusiasts and road managers should monitor these areas on a routine basis and treat infestations immediately.

- High use and critical areas will be delineated on a map.
- The responsible party will be assigned to monitor the sites.
- As species are inventoried, a treatment schedule will be developed. (See Appendix 3 for IWM for each species.) Multiple treatments will be scheduled that accomplish specific, effective control needs for the species present.
- The sites will be monitored periodically.
- All treatments will be reported to the UP by 11/20 of each year.

Priority #5: Eradicate or suppress inventoried, small, isolated infestations of High Priority species.

Eradication or suppression of small infestations will save considerable time and money in the future. Each species growth characteristics, keys to control, and appropriate control actions can be found in Appendix 4.

2011 List of High Priority Invasive Species within the WMA

- Yellow starthistle (*Centaurea solstitialis*). CO State List A
- Sulfur cinquefoil (*Potentilla recta*). CO State List B
- Leafy spurge (*Euphorbia esula*). CO State List B
- Yellow toadflax (*Linaria vulgaris*). CO State List B
- Oxeye daisy (*Chrysanthemum leucanthemum*). CO State List B
- Spotted knapweed (*Centaurea maculosa*). CO State List B

Priority #6: Eradicate or suppress inventoried, small, isolated infestations of Other Priority species

Eradication or suppression of small infestations will save considerable time and money in the future. Each species growth characteristics, keys to control, and appropriate control actions can be found in Appendix 4.

2011 List of Other Priority Invasive Species within the WMA

- Russian knapweed (*Acroptilon repens*). CO State List B
- Whitetop or Hoary cress (*Cardaria draba*). CO State List B
- Musk thistle (*Carduus nutans*). CO State List B
- Bull thistle (*Cirsium vulgare*). CO State List B
- Canada thistle (*Cirsium arvense*). CO State List B
- Houndstongue (*Cynoglossum officinale*). CO State List B
- Jointed goatgrass (*Aegilops cylindrica*). CO State List B
- Common burdock (*Arctium minus*). CO State List C
- Cheatgrass (*Bromus tectorum*). CO State List C

Priority #7: Manage large infestations of High Priority species by area

It is not possible to eradicate large infestations of High Priority species in the first year of treatment. Therefore, a multi-year strategy must be used. The short-term objective is to manage and contain High Priority species that have a propensity to spread. The long-term objective is the eradication of High Priority species within the entire WMA.

Priority #8: Manage large infestations of Other Priority species by area

Because resources are limited, large known infestations of other priority species in non critical areas will be treated as the last priority. Whenever feasible, as treatment is being accomplished for an area, all noxious weeds will be treated simultaneously.

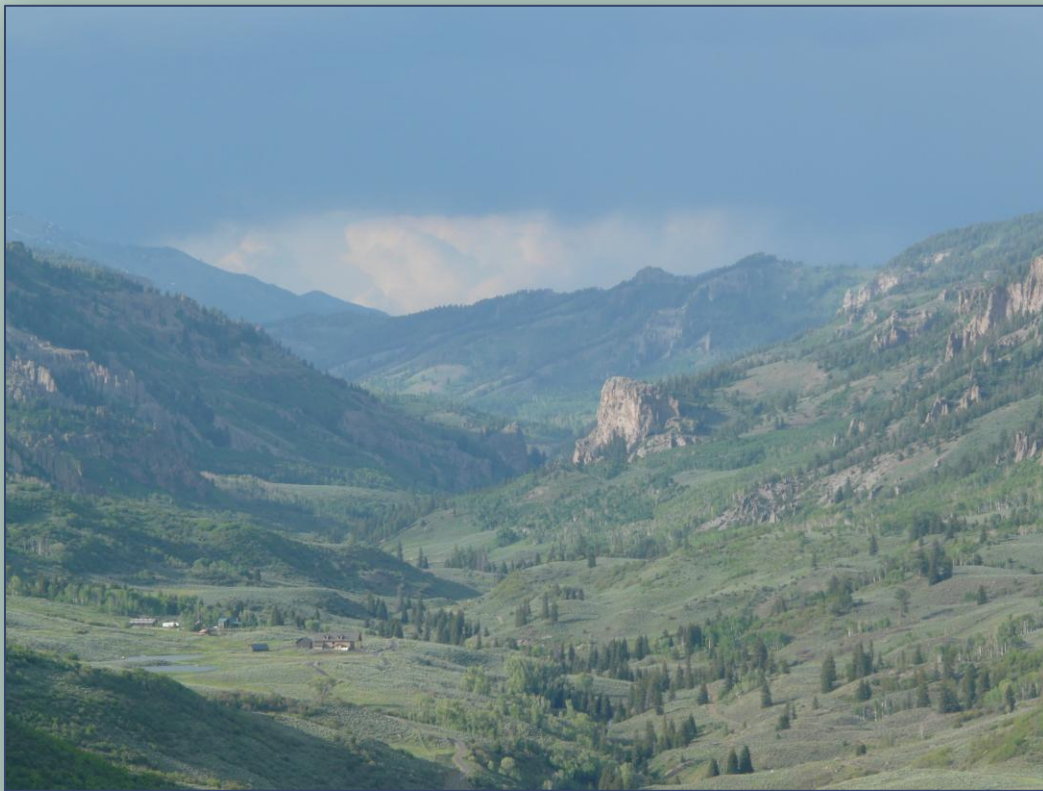
What would success look like in 5 years?

- Through Early Detection and Rapid Response Programs, all new infestations of new invasive species are eradicated upon detection.
- Weed Free Areas have increased in size.
- Inventoried acres of existing infestations have declined in size and a reduction in canopy cover or plant density has been achieved.
- Weed Prevention BMP's are common practices.
- Economic loss caused by invasive species and their treatment has been reduced significantly.

IX. RESTORATION OF NATIVE PLANT COMMUNITIES

One of the best ways to combat invasive species is to maintain a healthy plant community that withstands or resists weed invasion. Integrated Weed Management strategies present methods that are effective in controlling weeds, but restoring or improving a desirable plant community must be the long-term goal. Use native species for reseeding where available and do not introduce ornamentals without full knowledge of their potential to replace or take over the native vegetation.

Thank you for your support of a coordinated weed management program for the North Rim Landscape. Together we can stop the spread of weeds that, if left uncontrolled, will destroy the quality of our lands.



X. APPENDIX

A. Best Management Practices

EARLY DETECTION – RAPID RESPONSE

- Learn how to identify high-priority weed species.
- Report new infestations to the county weed supervisor or resource manager.
- If you find a small isolated patch of weeds, collect the seeds or flowers in a plastic bag for disposal and pull the weeds. Monitor the site periodically and repeat physical removal of the noxious weed or treat with herbicide.
- Inspect roads before maintenance to prevent the spread of weeds by equipment.
- Inspect ditch and stream banks to prevent spread of weeds downstream by running water.
- Inspect high traffic areas frequently such as trailheads, parking areas, campgrounds, corrals, water developments, or salt licks.
- Inspect bare soil or disturbed sites frequently for weeds. Re-seed these areas with an appropriate perennial plant mix.

PREVENTING THE SPREAD OF WEEDS

- Avoid the introduction of ornamental flowers that are on the Colorado invasive species list.
- Use weed free: forage for livestock, mulch for ground cover, seed mixes, gravel, fill material and topsoil.
- Avoid transporting weed seeds on clothing, pets, livestock, recreational vehicles (ATVs), vehicles, and ranch equipment.
- Clean all oil & gas, construction, fire and ranching equipment before entering the WMA.
- Confine livestock for two days in a small weed-free pasture before moving them into the WMA.
- Treat invasive species prior to implementation of construction or vegetation treatment projects.

MAINTAIN HEALTHY PLANT COMMUNITIES

- Re-seed disturbed areas immediately after disturbance ends with an appropriate perennial plant mix to minimize the opportunity for the invasion of invasive species.
- Livestock grazing should be planned and based on controlling the time and duration of grazing with moderate grazing levels.
- Restrict travel to established roads and trails.

B. Resources and References (include web sites below)

- Colorado State Weed Laws:
For more information visit the Colorado State website at:
<http://www.ag.state.co.us/CSD/Weeds/Weedhome.html>.
- Colorado Weed Free Forage Rules:
For more information visit the Colorado State website at:
<http://www.ag.state.co.us/DPI/WeedFreeForage/WeedFreeRules.pdf>
- Creating an Integrated Weed Management Plan:
<http://parks.state.co.us/NR/rdonlyres/E4FAAC68-00B4-44A8-A4E34C88B185BC78/0/IWMhandbooktext.pdf>

For More Information on invasive species, visit the following websites:

- www.blm.gov/weeds
- www.cwma.org
- www.plants.usda.gov
- invasives.fws.gov
- www.nawma.org
- www.wssa.net
- www.weedcenter.org

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- US Forest Service: David Bradford (970) 527-4131. dbradford@fs.fed.us
- NRCS: Tanya Banulis (970) 874-5726 ext. 118. tanya.banulis@co.usda.gov
- UP Staff: Jim Free (970) 275-0752. jcfree@msn.com

D. Integrated Weed Management Techniques

Reference material from Colorado State Parks Integrated Weed Management Handbook.

<http://dnrgoogle.state.co.us>

No single management technique is perfect for all weed control situations. Multiple management actions are required for effective control. The strategy of using an integrated selection of management techniques has been developed for use in a variety of “pest” control situations, including plant pests, or weeds. As used in this guide, Integrated Weed Management (IWM) is a process by which one selects and applies a combination of management techniques (biological, chemical, mechanical, and cultural) that, together, will control a particular weed species or infestation efficiently and effectively, with minimal adverse impacts to non-target organisms. Ideally, these management techniques should be selected and applied within the context of a complete natural resource management plan. Most traditional weed management treats only the symptoms of weed infestation, typically by using herbicides to kill weeds. IWM differs from ordinary weed management in attempting to address the ultimate causes of weed infestation, rather than simply focusing on controlling weeds. Although focusing on the fundamental causes of weed invasion and persistence is more demanding than simply spraying weeds, the rewards are far greater and are worth the effort. Over the long run, IWM should lead to greater success in meeting management objectives. IWM is “predicated on ecological principles and integrates multidisciplinary methodologies in developing ecosystem management strategies that are practical, economical and protective of public and environmental health” (Piper 1991). IWM seeks to combine two or more control actions which will interact to provide better control than any one of the actions might provide. However, even if multiple control actions do not interact, their additive effects can mean the difference between success and failure. In addition, employing multiple control actions should increase the likelihood that at least one of them will control the target weed species. *IWM is species-specific, tailored to exploit the weaknesses of a particular weed species, site specific, and designed to be practical with minimal risk to the organisms and their habitats.*

GENERAL PRINCIPLES

IWM requires landowners and managers to understand the biology and ecology of the weed species and its environment before selecting control actions. With scientifically valid information, landowners and managers can select the most effective, efficient, environmentally sound and socially acceptable methods to control weeds (Brown et al. 1999). Read the relevant weed profiles in Appendix 1 carefully before you develop IWM approaches for your problem weed species. Now that you have identified which species and which infestations are high priorities for control, use the following general principles and strategies in your selection of control measures and formulation of an IWM plan.

1. WORK TO ESTABLISH AND MAINTAIN FUNCTIONING NATIVE COMMUNITIES.

Grazing Management.

Grazing is the most extensive land use in Colorado, and poorly managed livestock grazing can contribute greatly to the invasion and spread of noxious weeds. Therefore, proper management of livestock is an essential component of integrated weed management for managing weeds on lands that are grazed. Perhaps the most important elements of a grazing plan are moving livestock from pasture to pasture to avoid overgrazing and to provide plants with adequate time to recover following grazing.

Other Land Use Practices.

Land use practices other than grazing can also help or hinder the spread of weeds. Look for instances where irrigation, haying, or recreational use may be contributing to the degradation of native plant communities, or otherwise promoting the invasion and spread of noxious weeds, and take steps to alter these practices as necessary. In some situations, a conservation easement may motivate these changes in land management practices.

Restoration and Revegetation.

One way to combat the problem of invasive noxious weeds is to use native plants for landscaping, revegetation, and reclamation. IWM considers the broader natural systems in which a weed species or infestation occurs and attempts to manipulate these systems in ways that result in control of the weeds in question. Control often is geared toward improving the health of desirable plant communities so they can withstand future weed invasion. Use native species for reseeding, and plant native trees or shrubs as appropriate. Encourage the growth and persistence of native species by taking care not to damage them or alter their habitat with unsuitable land management practices. For detailed information see the *Native Plant Revegetation Guide for Colorado* (CNAP 1998).

2. IMPLEMENT APPROPRIATE PREVENTION METHODS.

IWM also includes combining preventive measures with normal land management activities and weed control actions. Preventing weeds from invading a site is the most effective and least costly method for controlling weeds. As you consider control actions, remember that you will need to ensure that application of these actions does not contribute to the spread of noxious weeds.

3. CHOOSE APPROPRIATE CONTROL ACTIONS.

Selecting appropriate control actions requires a detailed knowledge of the biology and ecology of the target weed species. The selected control actions should ideally be ones that are:

Applied at the most effective time.

Most control actions are effective only during certain periods of the target species' life cycle. Treatments should be applied at the point in the life-cycle of the weed when it is most vulnerable, *and* at a time when the least damage will be done to its natural predators and other non-target species.

Least damaging to non-target organisms, including natural weed control organisms.

Landowners and managers should carefully consider the likely effects of available control techniques on both target and non-target species before deciding which combination of control measures to use. Non-target organisms may include sensitive species, native plant communities, wildlife, areas revegetated to control weeds, insect pollinators, insects that feed on target weed species, and plant species that compete with the weeds you are trying to control. The selected control actions must not significantly damage these non-target organisms or lead to the creation of further problems.

Least hazardous to human health.

Herbicides can be injurious to human health if not used correctly. In fact, one of the driving forces behind IWM is the reduction of unnecessary pesticide use. Chemicals should be carefully chosen to minimize their potential toxicity to humans. Successful weed management involves more than just spraying weeds. Similarly, mechanical tools such as mowers and chainsaws can be dangerous if not handled properly. Make sure you are familiar with the proper operation of such tools.

Least damaging to the general environment.

Using herbicides judiciously is important to avoid environmental contamination, especially around water. Certain formulations of herbicides cannot be used in aquatic situations or where ground water is close to the ground surface. In addition, timing of herbicide application is important to maximize the effectiveness of the chemical on the target weed, as well as to reduce the possibility of adverse side effects.

Most likely to reduce the need for weed control actions over the long-term.

Control techniques fall into two general categories: those that seek to prevent weeds from establishing, and those that deal with weeds which are already present. Preventive and cultural measures to reduce soil disturbances or to reduce the input of weed seeds to an area, re-seeding existing disturbed lands, and altering grazing practices to promote more vigorous stands of perennial plants are actions which work to prevent weed establishment. Actions which address existing weeds include pulling, mowing, applying herbicide, prescribed burning, grazing or releasing biological control insects. Any combination of these management actions which addresses the underlying causes of weed infestation and spread is likely to be the most beneficial for controlling weeds over the long run.

Most easily implemented.

Control techniques which are easier to apply are more likely to be completed, and therefore most likely to have an effect on weeds.

Most cost-effective in the short and long term.

Consider the benefits and the costs of the possible control actions. For example, is the potential damage to desirable vegetation from an herbicide worth the risk? Is the potential for contaminating a stream with an herbicide outweighed by the benefits of controlling a noxious weed? Is the potential for spreading weed seeds by driving your vehicle into an area infested by weeds outweighed by the increased ease of controlling weeds?

GENERAL STRATEGIES

Remember that weed management actions need to support your land management goals and your weed management objectives. Generally speaking, weed control objectives will be to eradicate, suppress or contain weed populations.

Eradicate means completely eliminating all weed plants, including live roots, rhizomes and seeds. Eradicating a weed species on a management area is very difficult unless it is present in small numbers.

Suppress means to reduce the abundance of a weed species, typically as measured or estimated in terms of canopy cover or plant density.

Contain means confining an infestation so it does not expand, but does not usually mean reducing the current infestation.

Tailor your management actions to the level of control you are seeking. For example, biocontrol agents might be appropriate for suppressing a weed population but not for eradicating a population.

IWM programs for large weed infestations generally select actions from the following list:

- Preventing weeds from becoming established in the first place.
- Altering livestock grazing practices to promote more vigorous plant growth.
- Using appropriate types of livestock to graze and thereby weaken weed plants and/or reduce seed production without damaging desirable plants.
- Re-seeding with a mixture of competitive, desirable plants, especially grasses, that spans the spectrum of growth periods (cool- and warm-season plants) and rooting depths (shallow and deep rooted).
- Releasing biological control insects to weaken weed plants and reduce seed production.
- Spraying with an herbicide selected to provide maximum weed control without damaging existing or newly seeded desirable plant species. A successful IWM program must be tailor-made for each situation. There is no cook-book solution that will work everywhere.

However, certain combinations of control actions have been successful and are worthy of your consideration:

- Mowing or cutting plus herbicide.
- Spraying with herbicide followed by reseeding with competitive plant species followed by hand-pulling of residual weed plants.
- Altering grazing regimes plus introducing biological control insects.
- Cutting woody plants followed by herbicide application.
- Grazing with goats plus reseeding with competitive plant species plus introducing biological control insects.
- Introducing biological control insects with periodic herbicide application.
- Spraying with herbicide followed with re-seeding with competitive perennial grasses.
- Re-seeding with competitive grasses followed by altered livestock grazing regime.

Remember that herbicides **must** be applied in conformance with the label. With herbicides, the label is the law. **Applying an herbicide beyond the bounds specified on the label is illegal.** Do not increase the concentration of an herbicide beyond the limits set by the manufacturer. More is NOT necessarily better, and higher herbicide concentrations can damage animals and non-target plants. The presumed safety of a chemical is based on the manufacturer's recommended concentrations only. IWM prescriptions potentially include the full range of control actions discussed in this handbook, including pulling, mowing and cutting, livestock, cultural controls, herbicides, prescribed burning, and biological control agents. The IWM approach contrasts with the traditional approach of using a single control action, such as applying herbicides, to treat all weed problems. Herbicides are one useful technique but they are not the only method to control weeds, and may not always be the most effective.

WEED MANAGEMENT TECHNIQUES

The need to take action to control weeds should be self-evident. All the planning in the world is worthless unless it is followed by action. A variety of specific weed management actions are presented below. As you consider the possibility of employing any of these actions to control noxious weeds, remember two key points:

1. An abundance of weeds is often symptomatic of certain environmental conditions. It is important to understand and deal with the underlying causes of weed infestation, and to take steps to counter them. If the factors permitting weed establishment and expansion are not addressed, weed problems will continue indefinitely.
2. A single control technique is rarely sufficient to control a particular weed species. The best results in weed control are usually obtained by combining different control methods in a coordinated effort. This strategy is known as Integrated Weed Management, and is the primary focus of this handbook. Weed management actions seek to achieve various levels of control. They are listed below in order of decreasing degree of control:

- Eradication, where a population of a weed species (including seeds) is completely eliminated.
- Killing an entire population of plants, with the expectation that they will repopulate an area from seeds in the soil.
- Weakening established plants with the hope that they will be more susceptible to mortality in the future or that their seed production will diminish.
- Thinning plants, where some plants in a population are killed but many are not.
- Eliminating seed production by damaging the top growth of plants. It is tempting to try to eradicate all weed populations because this represents the highest degree of control. However, eradication is not practical for most weed species and infestations because of the high level of effort involved. Eradication is generally appropriate only for small infestations of high-priority weed species.

PREVENTION

The most important weed management action is to prevent weeds from becoming established in the first place. The old adage that “an ounce of prevention is worth a pound of cure” certainly applies to weed management. There are two fundamental characteristics of weedy species that help explain why weeds become established where they do:

- Weeds specialize in colonizing highly disturbed ground. Weeds possess a number of physical traits that allow them to arrive at disturbed sites sooner and grow faster than other plants. With these advantages they are able to out compete native species, at least for a time. To counter this factor, avoid wholesale disturbance or destruction of existing vegetation whenever possible. Such disturbance, resulting in bare soil and lack of competing vegetation, creates ideal opportunities for weed colonization. If disturbance cannot be avoided, re-seed or re-plant disturbed areas immediately after the disturbance has ceased. Use native species or carefully chosen non-invasive introduced species so that “vacant” ground is quickly occupied by desirable plants. Extensive disturbances include house, pipeline, service or utility line, road and gravel pit construction, as well as road maintenance. On many properties road maintenance may be the most significant source of drastic disturbance. Work with local road district or state transportation office personnel to control weeds of rights-of-way that affect your property or management area.
- Weeds tend to invade plant communities that have been degraded by poor land management. Healthy native plant communities resist invasion. For information about establishing and maintaining native plant communities, see the *Native Plant Revegetation Guide for Colorado* (Colorado Natural Areas Program 1998). One of the best ways to avoid damaging plant communities is to manage livestock grazing so it maintains or increases the vigor of native perennial plants, especially grasses. Recreationists can also damage vegetation by overusing popular camping areas and creating social trails. Dense, vigorous stands of perennial grasses are especially resistant to weed invasion. However, certain highly aggressive noxious weeds such as leafy spurge, diffuse knapweed and Canada thistle can invade well-managed lands that have dense, vigorous vegetation.

PULLING

Pulling refers to using your hands or simple implements to uproot plants.

Pulling works best for.

- Small infestations of weeds that can be pulled one patch at a time.
- Annual and biennial plants (although seed banks will remain for some time).
- Shallow-rooted plant species that do not resprout from any residual roots.
- Plants growing on sandy or gravelly soils. If possible, concentrate pulling when the soil is moist and soft; for example, after a heavy, soaking rain.
- Situations where chemicals, motorized equipment or livestock cannot be used or are undesirable.
- Eliminating or reducing seed production in small infestations.

Pulling has limitations such as.

- Pulling generally does not remove the entire weed root system except under the most favorable circumstances. Thus, pulling is often ineffective for killing rhizomatous weed species such as Canada thistle, field bindweed, Russian knapweed, leafy spurge, or yellow toadflax even if used in conjunction with other techniques. However, if your goal is reducing seed production, pulling may be very effective. ***If pulled weeds contain seeds, they should be removed from the site and burned or disposed of in a landfill. Don't compost this material!***
- Pulling will not reduce a soil seed bank, although it can keep a seed bank in the soil from increasing.
- It is not cost effective for large infestations, due to the labor involved.

- Temporarily creating bare soil and providing more sites for weed seed germination and establishment.
- Some weeds produce chemicals that can cause allergic reactions or dermatitis in some people. Always wear work gloves and a long-sleeved shirt for pulling plants. Wash your hands with soap and water afterwards.

Cost of pulling.

- Labor is the primary cost associated with pulling. Labor costs vary widely depending on local conditions. A recent study in Montana found that hand pulling alone was effective at reducing flower production of spotted knapweed, but that it was 70 – 500 times more expensive per acre than the other treatments tested (Heap 1999).
- Disposal of flowering or post-flowering plants.

MOWING AND CUTTING

Mowing and cutting employ mechanical or hand tools to sever the aboveground portion of a plant from its roots.

Mowing and cutting work best for.

- Large, relatively flat and dry areas that can be mowed with few safety or equipment concerns.
- Preventing tall, erect biennial weed species such as mullein and teasel from setting seed when other control techniques are not feasible.
- Preventing the “tumbling” action of certain weed species such as diffuse knapweed, kochia and Russian thistle that spreads seeds of these species across wide areas.
- Weakening weed plants by depleting root and rhizome reserves through repeated mowing, in cases where such mowing can be conducted efficiently.
- Combining with other control methods, such as herbicide treatment. Cutting can be extremely effective for killing certain trees and shrubs if it is combined with herbicide treatment of the cut stumps. For example, cutting the stems as close to the ground as possible in the fall and immediately (within 30 seconds) painting the cut stumps with triclopyr herbicide kills tamarisk, Russian olive, Siberian elm, and crack willow.
- Large-scale restorations where weeds need to be controlled during the first growing season or two. In these situations, set the mower blade height relatively high so as to cut the taller weeds but to not cut the shorter, slower-growing desirable species.
- Relatively small areas where adequate labor is available.
- Small infestations of fleshy-stemmed biennial thistles are easy to cut with a sharp machete. These thistles include Scotch, musk, plumeless, and bull thistles.

Mowing and cutting have limitations such as.

- Rarely killing weeds.
- Sites that are inaccessible or too rocky cannot be mowed, although weed whips and machetes can be effective in such situations.
- Having to repeat mowing frequently for control to be effective.
- Cut plants resprouting to larger sizes than prior to cutting (tamarisk, Russian olive).
- Weakening some rhizomatous plants only slightly (for example, Russian knapweed) unless the frequency of cutting is very high.

Pitfalls of mowing and cutting include.

- Failing to remove and dispose of cut stems if they contain seeds.
- Dislodging rocks from the mower may be dangerous to the mower operator.
- Turning annual or biennial plants such as diffuse knapweed into short-lived perennials through repeated mowing.

- Weed seeds spread by mowing equipment to areas previously free of infestations. Clean equipment which has been used in weed infested areas before moving it to another area. Make sure that borrowed or rented equipment is free of weed seeds by inspecting equipment before it enters your property. Or you can insist that the equipment must be cleaned first.

Cost of mowing and cutting.

- Can be relatively low per acre for large areas that can be mowed.
- Can be reduced if you can trade goods or services with a neighbor, especially if the neighbor is motivated by the prospect of reduced weed infestations on his or her property.
- A tractor with a brush hog rotary mower costs about \$80 per hour or about \$50 - \$75 per acre.
- A three-person crew with weed whips costs about \$30 per hour.
- Equipment cost for cutting is modest, with a weed whip, a chain saw and a double-action lopper costing about \$800 total.
- Labor costs can be a barrier to cutting large areas of weeds such as tamarisk or Russian olive.

CULTURAL CONTROLS

Cultural controls seek to control weed problems by establishing desired plant species. Cultural techniques manipulate the plant community through cultivating (cutting through and turning over the soil), re-seeding, fertilizing and irrigating.

Cultural controls are most useful for.

- Large restoration projects. Cultivating is often necessary to reduce the number of weed seeds in the soil before planting desirable plant species. Cultivating for a year prior to reseeding kills weeds that have sprouted since the last cultivation and progressively reduces the bank of weed seeds. *Cultivation is not usually appropriate for natural areas because cultivation causes major disruption of established plant communities, and renders them susceptible to weed infestation.*
- Re-establishing native plant communities on disturbed or depleted areas so desirable plants can prevent or reduce weed infestation. *Disturbances such as pipelines, temporary roads, and construction sites need to be re-seeded immediately once the work is completed.* The *Native Plant Revegetation Guide for Colorado* (Colorado Natural Areas Program 1998) discusses this subject in great detail and provides practical advice to

landowners and land managers. Copies are available from the Colorado Natural Areas Program.

Cultural controls have limitations such as.

- Cultivating is not normally suitable for natural communities.
- Cultivating is appropriate only for restoration of drastically disturbed sites.
- Lack of seeds from locally adapted plants.
- Lack of seeds of certain native species, especially forbs and shrubs.

Pitfalls of cultural controls include.

- Seed mixes may be contaminated with weed seeds.
- Cultivation may result in wholesale germination and establishment of weed species if there is not adequate follow-up weed control.
- Temporary cover crops such as wheat, rye or barley used to reduce soil erosion must be mowed or grazed to eliminate their seed production.
- Promoting weed growth by adding unneeded nitrogen fertilizers. Native plant species are generally adapted to low-nitrogen conditions, while weed species are adapted to high nitrogen conditions. Only add nitrogen fertilizer if tests show that soil nitrogen levels are insufficient to support native species.

- Common components of commercial seed mixes such as yellow sweetclover, smooth brome, and Kentucky bluegrass are often considered weeds in the context of natural lands and natural areas.
- Importing weed seeds on borrowed or rented equipment. You can reduce this risk by inspecting equipment before it enters your property or you can insist that the equipment must be cleaned first.

Cost of cultural controls and reseeding.

- A typical cost of contracting out the cultivation of a 10-acre restoration area can range from about \$40 - \$100/acre, and may include a base fee for mobilizing equipment of something on the order of \$1000, assuming the equipment is available for hire locally.
- The cost of reseeding a construction site should be included in the cost of the project.
- The cost of seed is highly variable depending on species and availability. Common native perennial grasses commonly cost between \$3 - \$10 per pound. The cost of seed alone for reseeding an acre of land could vary from \$10 - \$50 per acre.
- A low-cost alternative to seeding is to use native (weed free) hay as a mulch and seed source.

LIVESTOCK GRAZING

Land managers can use cattle, sheep and goats to selectively overgraze certain weed species, thereby weakening them. In cases where desirable native species are not attractive to livestock, grazing may favor these species over weeds.

Livestock are most useful for.

- Weeds that are palatable (at least at some point during the year) and non-toxic to livestock. Weeds vary greatly in their palatability to types of livestock. Generally speaking, the preference for grasses declines from horses to cattle to sheep to goats. Furthermore, goats and sheep are more likely than horses or cattle to relish broadleaf weeds (forbs).
- Leafy spurge control. Goats and sheep are very effective control agents for all but the smallest infestations, especially in riparian areas.
- Low-level, widespread weed infestations where other control techniques are not cost effective.

Livestock have limitations such as.

- Lack of availability of goats and sheep or even cattle when and where you need them.
- Need for water and fencing or herding to control livestock movement.
- The need to manage the intensity and duration of livestock grazing carefully to avoid overgrazing, and allow desirable species to recover from grazing impacts.
- Areas where predators such as coyotes, mountain lions and black bears may kill grazing animals, especially sheep and goats.
- Using the proper kind of animal to manage the weeds on your property.
- Need for someone with knowledge of animal husbandry to manage the animals.
- Palatability of weeds varying widely throughout the growing season. For example, young shoots of Canada thistle are very palatable to cattle, while old, mature stalks are not. However, palatability of many weeds can be greatly increased by spraying them with a dilute solution of molasses.

Pitfalls of livestock include.

- Expecting livestock to control weeds without close management. Simply turning animals into a pasture and expecting weed problems to vanish would likely be counterproductive.

- Failing to manage the intensity and duration of livestock grazing to prevent the animals from depleting the desirable plant species they are grazing, or creating disturbance which favors the establishment of weeds.
- Spreading weed seeds in fur or in manure when animals are moved from one area to another. Grazing should be done before weeds set seed.
- Toxicity of weeds such as poison hemlock, halogeton, St. Johnswort and Russian knapweed to grazing animals; toxicity can vary greatly by type of animal.

Resources for livestock include.

- Contract grazing operators, typically using sheep and goats, are now entering the market place for the express purpose of controlling weeds.
- Neighbors with livestock are obvious allies in weed control and sources of grazing animals. They may be willing to provide the animals free of charge to you in exchange for a free grazing opportunity.
- There may be a potential profit opportunity where weeds could be turned into dollars in the form of specialized animal products.

Cost of livestock include.

- Infrastructure such as fencing and water, including capital and maintenance. Cost of fencing is highly variable depending on soil conditions, access and the type of fencing. Modern electric fencing is available that is much less expensive than barbed-wire fencing. Electric fence can be erected on a temporary basis while the animals are grazing then removed once grazing is finished. There are many sources of electric fence materials.
- The cost of contracting with a person to supply and manage grazing animals. You can expect to pay from \$19 - \$38 per acre to rent goats and sheep for the grazing season.
- Cost of creating a holding area to confine animals (for 10-14 days) which have been grazing weedy areas where weed seeds are present.

BIOLOGICAL CONTROL AGENTS (INSECTS)

Biological control agents are organisms (usually insects) that are deliberately introduced to an area to control weeds. The aim of biological control is not eradication, but rather to exert enough pressure on a weed to reduce its abundance to acceptable levels (Wilson and McCaffrey 1999).

Biological control agents are most useful for.

- Reducing seed production or weakening plants.
- Large, dense infestations where other control methods are not cost-effective.
- Situations where a reduced but effectively permanent presence of a noxious weed species is acceptable.

These noxious weed species have biological control programs in Colorado:

- Leafy spurge
- Diffuse and spotted knapweed
- Russian thistle
- Puncturevine
- Musk thistle
- Yellow and Dalmatian toadflax
- Bull thistle
- Canada thistle
- Russian knapweed
- Purple loosestrife

Biological control has limitations such as.

- Failing to eradicate the target plant species. Do not use biocontrol agents where you seek to eradicate a weed population. Eradication of weeds with biological agents never occurs.
- Use of biological control is effectively an admission that a particular weed species is here to stay and that this is acceptable.
- Feasible for only a handful of weed species due to the high cost of finding, screening and testing potential control organisms. Biological controls have a mixed record with some tremendous successes but also with many failures.
- Rarely successful as the sole means of control of a weed species.
- Lack of effective biological control agents for most noxious weed species.
- Biological control agents being unavailable when you want them.
- Necessity of having a reservoir of host weeds to support biological agents over the long term. Thus, it may be necessary to leave some weeds to support populations of control organisms. This may be unpopular with neighbors or the public.
- Degree of control is variable and will take several years to achieve.

Pitfalls of biological control agents include.

- Insects attacking beneficial, non-target plants. For example, the seed weevil *Rhinocyllus conicus* that has been used to control musk thistle also attacks native thistles. There are indications that this weevil is adversely affecting a rare thistle (*Cirsium ownbeyi*) in Colorado (C. Dawson, pers. comm.). The weevil *Larinus planus*, introduced for control of Canada thistle, has been reported to attack native thistle species as well (S. Louda, pers. comm.). Insects that have been released to control St. Johnswort also feed on native *Hypericum* species, and some insects released for leafy spurge control also attack native spurge species (Wilson and McCaffrey 1999).
- Inability to establish populations of biological control organisms for reasons relating to climate, soils and so forth that are not well understood.

The biology behind biological control.

In its native environment, a plant is constantly attacked by a variety of organisms. Herbivory by insects and other invertebrate animals, and infection by fungi, bacteria and viruses reduces the ability of plants to grow and reproduce, which regulates the population size of a species. When plants are transported to a completely new environment, insects and other organisms in the new environment may not be adapted

to feed on or otherwise control the plant species. If this is the case, the introduced plant species may be able to expand its population size enough to become a troublesome weed. One method of controlling weeds involves finding organisms in the plant's native environment that attack the plant and reduce its growth and/or reproduction. After a lengthy period of laboratory and field testing to determine if the organism is likely to attack non-target plants, these organisms may be released to control the weed in its new environment. The federal government approves individual insect species for release as biological control agents. Generally, federal land management agencies are not required to perform additional reviews to release approved biocontrol agents. Other organizations may have internal policies that govern the intentional release of biological control agents.

The Biological Pest Control Section of the Division of Plant Industry has ongoing biological control programs for thirteen noxious or problem weed species. The primary function of the Section is the rearing and releasing of natural enemies for control of specific plant and insect pests. The rearing is done at the Insectary at Palisade. Currently, a total of 29 species of weed predators are being

cultured, released, and established on weed infestations throughout the State. Most of these species are available if they have been established in Colorado. The Biological Pest Control Section encourages anybody who is interested in these programs to call for the insects. The requests are put on a list and when the insects are available, the land manager is contacted to arrange the release.

Resources for biological control agents include.

- The Colorado Department of Agriculture's Insectary in Palisade rears biological control insects and provides them free of charge to Colorado residents. Consult your county weed supervisor to find out if biological control agents have been used successfully in your area or call the Insectary at (970) 464-7916.

Cost of biological control agents.

- Biological control agents are available free of charge from the Insectary. Availability is limited.
- Insects are available for sale from commercial sources, often for several hundred dollars for a sufficient number of insects for one release.

HERBICIDES

Herbicides are chemicals that kill or injure plants. There are many kinds of herbicides; some are derived from plants and others are manufactured synthetically. Herbicides can be classified in terms of their mode of action. These chemicals include growth regulators, amino acid inhibitors, grass meristem destroyers, cell membrane destroyers, root and shoot inhibitors and amino acid derivatives which interfere with plant metabolism in a variety of ways.

Herbicides work best for.

- Eradicating some weed species in certain situations. Herbicides are most effective on pure stands of a single weed species where desirable non-target plants are scarce or absent. In this situation, one often has the option of selecting from several different herbicides.
- Rhizomatous weed species that are unpalatable to livestock, require repeated pulling or cutting for control, or are located in remote areas where pulling or cutting are not feasible.
- Small patches of weeds where hand pulling or cutting is not effective or feasible.
- Use in combination with other control methods. For example, Canada thistle can be controlled by repeated cutting during the growing season followed by treatment with clopyralid herbicide in the fall. As noted previously, tamarisk, Russian olive and Siberian elm can be controlled very effectively by cutting stems very close to the ground in the fall then immediately spraying or painting the cut stems with triclopyr herbicide.

Herbicides have limitations such as.

- Damaging or killing non-target plants. Herbicides are not completely selective in their toxicity to the target plant species. Effects on non-target plants can be minimized by selecting an appropriate herbicide and using a wick or a backpack sprayer. A wick is made from adsorbent material and saturated with herbicide. This wick is rubbed directly against the weeds so the herbicide is not applied to adjacent, desirable plants.
- Difficulty of using herbicides to control small weeds when they occur among taller desirable plant species.
- Toxicity to humans to varying degrees. Thus, their use is regulated by federal and state laws. People who use herbicides need to know these regulations. Certain herbicides are classified as "restricted use herbicides" whose application is limited by federal and state regulations.
- Restricted use herbicides are often available only at licensed outlets such as your local farm coop or by ordering through reputable distributors.

- Property owners must possess a private applicator's license to apply a restricted use herbicide on their property. This license is obtained by passing a test administered by the U. S. Environmental Protection Agency in Denver. Call the Private Pesticide Applicator office at (303) 312-7283 for more information.
- Herbicides must be applied in conformance with the label. With herbicides, the label is the law, and applying an herbicide beyond the bounds specified on the label is illegal.
- Certain herbicides may not be used around or on water. This is an important consideration for weeds such as Canada thistle, perennial pepperweed, purple loosestrife, and tamarisk that grow in wetlands or riparian areas.
- One must possess the proper equipment and requisite knowledge to apply chemicals safely. Proper clothing must be used, and materials to contain spills must be on hand when using herbicides.
- Herbicides can move beyond the area where they are applied and affect non-target plants and animals. This drift can be eliminated by using a wick or reduced by spraying under calm wind conditions and by adjusting the sprayer apparatus to produce large droplets.
- Populations of weeds may develop resistance to a particular herbicide over time.
- Opposition to the use of chemicals in the environment, especially in urban areas. Local opposition in some areas may pose challenges for the use of some or all herbicides.
- Like most other control methods, herbicides are short-term solutions that do not address reasons for weed problems in the first place. Therefore, spraying an herbicide treats a symptom of a problem. Even if an herbicide eradicates a weed infestation, another infestation may appear if the underlying cause of the infestation persists.

Pitfalls of herbicides include.

- Simplifying diverse plant communities by suppressing certain plant species, although this effect may be temporary.
- Herbicide applicators who cannot distinguish noxious weeds from desirable plant species, resulting in accidental damage to the latter.

Resources for herbicides include.

- The Division of Plant Industry in the Colorado Department of Agriculture can direct you to information about herbicides.
- Herbicide labels are an important source of information that people who use herbicides need to read carefully.
- Professional, licensed herbicide applicators are knowledgeable about herbicides. Most readers of this handbook will probably want to use the services of an applicator familiar with natural area situations, rather than just lawns and turf. Your county weed supervisor can provide you with the names of licensed applicators in your area. A directory of commercial applicators is also available from the Colorado Weed Management Association web site: http://www.cwma.org/3_weed_control.html.
- Chemical company sales persons are also sources of information, particularly about the products they sell.

Some herbicide terminology.

Formulation refers to how the herbicide is packaged. Sprayable formulations are diluted with water or oil-based carriers and sprayed on vegetation or soil. Dry formulations are granules or pellets and are spread directly on the soil. A herbicide **formulation** consists of an active ingredient, an inert carrier, and possibly adjuvants. The **active ingredient**

(a.i.) is the chemical which is primarily responsible for the herbicide's toxicity to plants. The **inert ingredient(s)** or **carrier** is a solvent or dilutant that makes the active ingredient soluble and able to penetrate plant tissues. Water is the most commonly used carrier. Hard or dirty water can decrease herbicide effectiveness, especially for glyphosate and 2,4-D salt or amine formulations (Bussan and Dyer 1999). **Adjuvants** are substances added to a formulation to increase the effectiveness of the active ingredient. These include surfactants, antifoaming agents, activators, drift control chemicals and dyes. The actual volume of spray solution is called the **spray gallonage**. Using the correct spray gallonage is important for ensuring good coverage of weed foliage with foliar-active herbicides (Bussan and Dyer 1999). Note that herbicide manufacturers are not required to disclose all ingredients in their products. Inert ingredients and adjuvants may also be dangerous chemicals -- always check the Material Safety Data Sheet (MSDS) for an herbicide. Remember, **THE LABEL IS THE LAW**. It is illegal to apply herbicides beyond the amounts specified on the label. If you have questions about a particular herbicide, call the 1-800 number on the label, or contact your county weed supervisor.

Cost of herbicides.

- The cost of herbicide alone commonly runs from about \$5 – \$20 per acre.
- The cost of herbicide application (not counting the chemical) depends greatly on the size of the area being treated, the chemical(s) are being used, and whether you apply the herbicide yourself or hire someone to do it for you. Cost for custom application runs from about \$50 - \$75 per acre for areas from one to one hundred acres using small equipment. For larger areas that are accessible for large equipment, costs can drop dramatically. Aerial application can run about \$20 per acre (not including the cost of the herbicide) for areas over one hundred acres. Note that any person who applies herbicide for a fee must be licensed by the State of Colorado.

Herbicide resistance.

Starting with the introduction of 2, 4-D in 1946, agrochemical companies have manufactured and brought to market a wide variety of herbicides. The success of herbicides and other crop protection chemicals have revolutionized weed management, farm practices and food production. However, the utility of herbicides is being threatened by the appearance of herbicide resistant weeds. In any weed population, there are likely to be individual plants which are able to survive herbicide treatments which kill most of the population. This naturally occurring heritable characteristic enables these individuals to survive and reproduce, producing a population which becomes resistant to herbicides over time. Currently, there are over 216 herbicide resistant weed biotypes worldwide with an average of nine new cases per year (Heap 1999). In Colorado, three weed species have been listed as herbicide resistant (Heap 1999). Redroot pigweed (*Amaranthus retroflexus*) has become resistant to atrazine, wild oat (*Avena fatua*) has become resistant to dicoflop-methyl, and kochia (*Kochia scoparia*) has become resistant to both atrazine and metsulfuron-methyl (Heap 1999).

PRESCRIBED BURNING

Prescribed burning is planning, setting and managing fires to accomplish resource management objectives. Prescribed burning is a complicated subject and will not be discussed in great detail here. Consult land managers and scientists who have experience with local conditions if you are contemplating prescribed burning.

Prescribed burning works best when.

- The noxious weed species you want to control is much more susceptible to the effects of burning than are the intermingled desirable plant species.
- Controlling cool-season grasses in prairie restorations.

- A proper monitoring plan is in place to evaluate the effects and success of the project.

Limitations of prescribed burning include.

- The need for intensive planning to insure that the burn will be safe and accomplish the intended resource management objectives.
- Smoke management problems, especially in urban areas, that limit your ability to burn.
- Availability of crew members who have “red cards” that signify a minimal level of fire training.
- Availability of experienced crews to manage the prescribed burn in your particular fuel type(s).

Pitfalls of prescribed burning include.

- The possibility of burns getting out of control and damaging property and endangering human life.
- Liability issues if a fire gets out of control.
- Arid environments can not tolerate frequent burning.
- Massive germination and establishment of weed seeds following burning. However, this may be advantageous, in that it may assist in the depletion of the bank of weed seeds in the soil, if you are prepared to control the resulting weeds.

Resources for prescribed burning include.

- Colorado State Forest Service. Trained CSFS staff can prepare prescribed burn plans for private landowners for a modest charge.
- In-house fire experts of state and federal land management agencies can advise public land managers about prescribed burning and prepare prescribed burn plans.
- Certain county open space programs have in-house fire experts who may be willing to share their experience with you and to direct you to additional knowledgeable people.
- Private consultants and contractors who specialize in prescribed burning.

E. Monitoring Techniques

Developing Permanent Photo Points

Permanent photo points are an easy and effective method to evaluate management actions and determine the progress of a weed control program. Comparing photographs of the same site taken over a period of several years furnishes visual evidence of vegetation changes. Photo points should be established before initiating a control program in an area to ensure that there is a record of the resource situation prior to changes in management. Photographs, both close-up and general view, should be obtained at each evaluation site. It is very important to accurately identify each photograph.

A. Equipment

1. Stakes (metal or fiberglass rod)
2. Plot frame (3x3 or 5x5 foot metal or fiberglass frame)
3. Photo identification label
4. 35 mm camera (ideally with a 29 mm wide-angle lens)
5. Color prints
6. Post (for marking location of the site) (metal or fiberglass)
7. Post driver
8. Orange spray paint (for marking post)
9. Compass or GPS unit

B. Site Selection

At least one permanent photo point should be located in each key area. Key areas are “critical” sites within the project area where the proposed treatment should have a significant impact. The number of key areas needed in a WMA will be influenced by soils, vegetation, topography, etc., and number of acres involved in the project. Key areas may be selected on the basis of environmental, social, and/or political criteria.

C. Procedures

1. Mark the key area with a permanent transect location post (spray post with orange paint). Locate a typical area about 25 feet from the transect location post. Record the exact distance and compass heading. Mark the plot with a stake. This will be the permanent “close-up” photo print.
2. Number the site on the photo identification label. Locate the identification label in the center of the plot. Focus on the identification label when taking the photographs.
3. Timing: Photographs should be taken when the weed is most visible (flowering) and at the same time each year.
4. Close-up Photographs: Place the square frame next to the stake. Place the photo identification label flat on the ground. The camera point, or location from which the photograph is taken, should be on the north side of the photo plot so there are no shadows across the photo. To take the photograph, stand over the photo plot with toes touching the edge of the frame. Include the photo label in the photograph.
5. General View Photograph: General view photographs present a broad view of a study site. The photo identification label is placed in an upright position so that it will appear in the foreground on the photograph. To take general view photographs, stand at the

transect location post, include the photo label, a general view of the site, and some sky in the photographs.

6. Repeat Photographs: Photographs should be taken at the same time each year using the above procedures. Be sure to use the same 35 mm camera and face the same direction each year when taking repeat photographs.

- D. Narrative: A narrative must accompany each photograph so the results can be interpreted. Estimate canopy cover as: Low – 5% or less, Moderate – 5% to 25%, High – 25% or more.

G. Maps