Chapter III: Alternatives

Introduction

This chapter describes the alternatives analyzed, including the preferred alternative and alternatives considered but dismissed from further analysis. It is organized using the following sections:

A. Alternative 1 - No Action (Continue Current Management)
B. Alternative 2 – Implement Comprehensive Invasive Plant Management Program (Preferred)
C. Alternatives Considered But Dismissed
D. Environmentally Preferred Alternative

The Alternatives were developed from collaborative interdisciplinary analysis based on the expertise of interdisciplinary planning team members. Internal and external scoping with Native American Tribes, federal, state and local agencies, interested organizations and individuals was also critical to the formulation of alternatives. The range of alternatives includes what is physically possible, acceptable by policy, and feasible for park resource managers. Reasonable alternatives would protect park natural and cultural resources; demonstrate effectiveness, efficiency, and cost-effectiveness for eradicating or controlling nonnative plant infestations; and ensure human safety.

The following goals guided development of the Alternatives. The plan for long-term management of invasive plants would:

- Comply with NPS policies and applicable laws and regulations;
- Encompass both existing and planned activities at each park;
- Address and integrate the activities in the parks that contribute to the introduction, spread, prevention and control of invasive plants;
- Address both broad-scale and site specific issues at each park;
- Integrate the plan with existing management plans at each park; and
- Provide a flexible decision-making framework to facilitate future management of newly discovered nonnative invasive plants and treatment options.

Under both alternatives, this plan considers all treatment methods that are currently being implemented by the park units, or that may be used in the foreseeable future (some parks currently have a more limited program), including cultural, manual/mechanical, biological, chemical (pesticide) and fire treatments.

The 11-Step Integrated Pest Management (IPM) Process

1. Describe your site management objectives and establish short and long term priorities.
2. Build consensus with stakeholders, occupants, decision makers and technical experts (ongoing).
3. Document decisions and maintain records.
4. Know your resource (site description and ecology).
5. Know your pest. Identify the potential pest species; understand their biology and conditions conducive to supporting them (air, water, food, shelter, temperature and light).
6. Monitor pests, pathways, and human and environmental factors, including population levels and phenological data.
7. Establish "injury thresholds," the point at which no additional damage or pest presence can be tolerated. This is the action threshold at which a pest management action will be implemented through an approved IPM strategy.
8. Review available tools and best management practices. Develop a management strategy specific to your site and identified pest(s). Tools can include: 1) no action, 2) physical, 3) mechanical), 4) cultural, 5) biological, and 6) chemical management.
9. Define responsibilities and implement the lowest risk, most effective strategy, in accordance with applicable laws, regulations, and policies.
10. Evaluate results. Determine if objectives have been achieved; modify strategy if necessary.
11. Education and provide outreach. Continue the learning cycle. Return to Step 1 (NPS 2003).

The alternatives were developed using an IPM approach. IPM is a decision-making process that integrates knowledge of pest biology, environmental protection, and available technology to treat pests (in this case, invasive plants) with the most effective and cost-effective methods that pose the least risk to

people, park resources and the environment. The use of IPM is mandated by federal law (FIFRA) and NPS policy.

WHERE DID INVASIVE SPECIES COME FROM?

Invasive species have been introduced to parks through a variety of means. Many invasive species were introduced prior to the establishment of some parks. Some park lands include old homesteads and mining sites from early European settlers. Settlers often brought with them plants or animals from their previous homes. Occasionally these plants or animals got loose and spread across the landscape. Many introductions of invasive plants have also resulted from garden plantings of ornamental species, such as toadflax and periwinkle. Some species, such as tamarisk and kudzu were introduced through restoration efforts to reduce soil erosion (NPS 2010a).

Today, the majority of invasive species are introduced unintentionally. Introductions can result from essentially every person, pet, or vehicle coming in and out of a park. Common sources are infested construction materials such as gravel, wood, mulch and fill. Contaminated vehicles such as equipment, boats, and passenger vehicles; personal gear such as boots, wetsuits, and tools, and wind- and water-borne seed materials are also vectors. Given the variety of pathways through which invasive species can enter a park, invasive species prevention and management affects all aspects of park operations (NPS 2010a).

A. Alternative 1: No Action (Continue Current Management)

1. Introduction: Invasive Plant Treatment at Partner Parks

Under Alternative 1, invasive plant treatment at the 10 Northern Rocky Mountains parks would continue to use existing invasive plant management programs and practices. Control at several of the parks would continue to consist primarily of annual actions accomplished by EPMTs. Although NRM-EPMT work is coordinated with parks, as to the timing of the visit and the treatment of invasive species, NRM-EPMT actions are often entirely accomplished by NRM-EPMT staff (currently based at Craters of the Moon National Monument and Preserve, Yellowstone and Glacier national parks). Some parks, such as City of Rocks, Craters of the Moon, Fossil Butte, Grant-Kohrs, and Little Bighorn would also continue ongoing park programs conducted using park staff and volunteers to reduce nonnative invasive species. Bear Paw, Big Hole, Golden Spike, Hagerman Fossil Beds, and Minidoka would likely continue to rely primarily on the NRM-EPMT to accomplish nonnative invasive plant treatment in the near future.

EPMTs assist parks with identifying and rapidly responding to new invasions, and reducing existing infestations. Some EPMTs also assist with restoring native plant communities. The Exotic Plant Management Program now supports 16 teams working in over 225 park units. The NRM-EPMT serving the 10 partner parks began in 2003. EPMTs are led by individuals with specialized knowledge and experience in invasive plant management. Each field-based team operates over a wide geographic area and serves over a dozen parks to increase operational efficiency. In addition to NPS staff, the EPMTs work with volunteers, contractors, and service organizations to meet the NPS mission, which includes preservation of native habitats for the enjoyment of future generations (NPS 2010a).

Overview

Alternative 1 would continue current programs and practices. As a result, current resource conditions and trends would also likely continue. With ongoing work by the parks and NRM-EPMTs to manage invasive plants, the acreage and plants treated would likely continue to increase or decrease as new populations were identified, treated and controlled. Craters of the Moon has seen a doubling in the area treated over the last few years because there have been more staff to survey weed extent and to treat weeds. Most of the other nine parks, which are smaller and easier to survey, would likely continue to experience a more moderate incremental increase in treatment as new invasive plants and populations arose or were discovered. Invasive plants would therefore likely continue to emerge and to spread in some areas at each of the parks. New plants and new infestations would continue to be treated as a high priority by the NRM-EPMT crews, according to the park's established priorities and practices.

Although Alternative 1 would continue existing programs at the partner parks, these programs and their implementation are applied inconsistently and are therefore highly variable among the parks.

The *Overview of NRM-EPMT Work* section in Chapter I: *Introduction* and Appendices J and K provide a history of invasive plant treatment that has occurred through the NRM-EPMT at the parks. Although most NRM-EPMT work includes spraying of herbicides, hand-pulling and other treatment methods are also used. Additional information about park programs is found in this chapter (see Table 14 and "Summary of Current and Past Treatment at Partner Parks" under 4) *Conducting Treatments*).

Existing programs in the parks consist of the following program components and are described within the framework below, although not all of the 10 parks currently have all of the components. The description of Alternative 1 is arranged based on the typical components of a comprehensive invasive plant management program:

- Prevention and Early Detection;
- Determining Weed Treatment Priorities;
- Conducting Treatments (description of current program);
- Monitoring;
- Recordkeeping;
- Interpretation and Education;
- Partnerships; and
- Measures to Avoid, Minimize or Mitigate Impacts.

Each of these components is discussed generally and then as applicable to the 10 parks. Where parks employ their own strategies, descriptions or examples are given showing how the components are implemented. Even though these components are listed systematically below, with some exceptions, the 10 parks generally have not employed as systematic a strategy as implied by this arrangement to address the invasion and spread of nonnative species.

Under this alternative, resource managers would continue to implement some or all of the components of an invasive plant management program. Ongoing activities, using existing methods, would continue.

2. Prevention and Early Detection

a) Application of Law and Policy

The parks would continue to comply with weed management laws and policies to identify and prevent the spread of nonnative invasive plants. Among the sources that would be used include:

- Federal and state weed laws;
- Executive Orders pertaining to weed management;
- *Management Policies*, Chapter 4 (NPS 2006);
- NPS Director's Orders;
- Regional programs and policies, such as Pesticide Use Proposals (PUPs), Biological Control Use Proposals (BUPs), Pesticide Use Logs, Material Safety Data Sheets (MSDS) Logs, and Label Logs;
- State laws, including Certified Applicator Licensing (ID, MT, UT and WY) and Noxious Weed Free Forage (MT);
- State / federal noxious weed lists;
- County weed laws;
- APHIS / Biocontrol Transport Permits;
- Application of prevention strategies; and
- County weed lists.

All parks are familiar with applicable federal, state and county weed management laws and policies and would continue to use these to determine which weeds to treat.

b) Best Management Practices

Prevention is one of the most important components of an invasive plant management program and is also considered a cultural technique for managing invasive plants (see section 4. *Conducting Treatments*).

The most environmentally and ecologically sound approach to manage invasive species is to prevent their introduction. While prevention is not easy, it is a high priority. It involves identifying and avoiding the most common methods of nonnative invasive plant introduction (including seeds, rhizomes, and stem fragments).

The following are some of the best management practices used by the parks to prevent the introduction and spread of nonnative plants:

- Use of certified weed free forage for park stock and pack animals (Craters of the Moon, Bear Paw and Big Hole during commemorative events).
- Use of local native seed purchased or collected for revegetation (Craters of the Moon, Grant-Kohrs, and Little Bighorn).
- Use of certified weed free straw and mulch used for construction and stabilization projects (Craters of the Moon).
- Use of certified weed free forage where livestock are allowed within natural areas (Craters of the Moon).
- Ongoing monitoring for known nonnative species managed as part of cultural landscape (Grant-Kohrs).
- Reseeding or revegetation of disturbed areas following construction (Big Hole, Craters of the Moon, Grant-Kohrs, and Little Bighorn).
- Retention and replacement of topsoil during construction (Craters of the Moon and Grant-Kohrs).
- Washing vehicles having contact with soil or materials that may contain noxious weed seed prior to working in weed free areas or transporting weed free materials (Craters of the Moon).
- Incorporating invasive plant prevention and control into project planning (all parks).
- Avoiding or removing sources of introduction and spread of invasive plant seed and propagules to prevent new invasive plant infestations and the spread of existing nonnative invasive plants (all parks).
- Minimizing disturbance (to avoid promoting invasive plant germination and establishment) (all parks).
- Re-establishing native vegetation to prevent conditions conducive to establishment of invasive plants when construction or other projects create bare ground (all parks).
- Improving the effectiveness of prevention practices through invasive plant awareness and education (Craters of the Moon, Fossil Butte, and Little Bighorn).
- Conducting education and outreach programs such as educational posters, events, Cooperative Weed Management Association participation (Grant-Kohrs and Little Bighorn).

EARLY DETECTION AND RAPID RESPONSE (EDRR)

This is a strategy employed by the EPMTs and parks. It means locating a potential invasive species just as it is beginning to invade a particular area and quickly treating the new infestation. This concept is fundamental to effective invasive species management. Early identification and treatment makes successful control more likely because it happens before the plant becomes widespread. As a result, it can save money and resources for other park priorities. To be most effective, EDRR relies upon a strong communication network and the education of visitors, neighbors, and employees about potential invaders (NPS 2010a).

The most effective time to treat invasive species is when the infestations are new to an area and populations are small. The teams assist parks in identifying new infestations and can quickly move to treat these infestations before they spread. This concept is central to the effective management of invasive species (NPS 2010a).

Additional strategies used in Alternative 1 are listed in section 8: *Measures to Avoid, Minimize or Mitigate Impacts.*

NRM-EPMT actions also contribute to prevention practices by implementing a combination of early detection, education, and adaptive management strategies. The teams assist parks and resource managers in developing and implementing best management practices. This facilitates sharing effective management strategies between parks and land managers. The teams also use outreach opportunities to educate parks, agencies, tribal governments, community groups, and landowners. At some parks, EPMTs participate in community events such as park specific weed awareness programs.

The following best management practices are among those that have been promoted by the EPMTs:

- Cleaning vehicles and equipment (at a site where waste water can be contained) before moving them from an infested area to a new area, such as prior to entry and reentry into partner parks.
- Requiring clean fill dirt to be used when an area needs re-contouring.
- Requiring appropriate native or non-invasive species to be used during restoration of a site (when local seed is not available).
- Installing boot-cleaning devices at trailheads and/or boat launching stations.

c) Early Detection and Rapid Response (EDRR)

While prevention is a high priority, of equal importance is actively watching for new invaders and acting quickly to remove them before they can establish and spread. Ongoing monitoring of park landscapes is critical and this is the foundation of an early detection rapid response (EDRR) network. A well-developed EDRR program has the potential to save the parks a great deal of time and money. Too often management of an invasive species does not begin until the plant is readily visible in the landscape, after it has had a number of years to establish, develop a seed bank, and expand into adjacent areas. As time passes and the population of the invasive species increases, the potential for eradication often decreases. Eventually, control is unlikely without major resource inputs that also may also have extensive environmental impacts. Parks employ a range of programs from the formal to informal to accomplish the task of early detection and rapid response. EDRR allows limited resources to be spent more efficiently on proactive weed management by focusing on prevention or early detection of new invasions.

The following examples from a few of the parks illustrate how EDRR has been employed.

1) In 2004 and 2005, the NRM-EPMT identified and hand-pulled two small infestations of yellow starthistle at Minidoka. Although it was not present in 2006, yellow starthistle was found again in 2007-2009. This infestation of yellow starthistle has been contained with minimal annual treatment; however, annual monitoring of these sites is likely to remain a high priority for many years due to the existence and longevity of seed in the soil. When infestations are detected early and treated before establishment, it is often possible to prevent their spread.

2) In 2004, two small infestations of Dalmatian toadflax were inventoried during a baseline weed survey at Little Bighorn. Both sites were treated chemically during that growing season. No plants were detected at either site from 2005-2007. In 2008 and 2009, however, several plants were found at one site. These were hand-pulled. Two new sites with infestations were also found and inventoried in 2009; each contained a few individual plants. The plants were hand-pulled and park staff returned in 2010 to monitor all sites. All four sites are scattered widely across the park suggesting long-distance seed dispersal, either from local infestations outside the park or from the seed bank at the two sites inventoried in 2004. Initially, minimal efforts utilizing EDRR kept Dalmatian toadflax from spreading across the battlefield prairie. Monitoring results from 2010 however indicate that this plant is spreading despite these efforts.

3) In 2007, a new invasive species, dyers woad, was discovered in the southwest part of the Craters of the Moon on the Wapi Flow (in the Great Rift Wilderness Study Area). Initial control was coordinated between the NRM-EPMT and the park's Student Conservation Association (SCA) crew and included

four days spent hand collecting and bagging seed heads with millions of seeds. Where plants had not gone to seed, the infestation was also treated with herbicide.

Unfortunately, this EDRR example did not illustrate the importance of early detection in ease of control. Additional surveys found that the infestation was much larger than previously thought. These extended surveys have continued to find infestations across the entire southern boundary of the Wapi Flow, which continue to be treated by the park and NRM-EPMT in an effort to contain the spread.

d) Observing Quarantines

The parks would continue to observe quarantines established by APHIS or the states. Quarantines are used to reduce the spread of invasive plants.

e) Education

Education is a key part of prevention and early detection but because it is also a major part of national park invasive plant programs, it is discussed together with interpretation below (see section 6. *Interpretation and Education*).

f) Restoration (see section 3. *Conducting Treatments*, Cultural Techniques below)

3. Determining Weed Treatment Priorities

In Alternative 1, current decision-making about which weeds to treat varies among the parks, however it is generally determined by the park based on state and county noxious weed lists and knowledge of the size and location of the infestation. Park priorities may or may not be determined in consultation with the NRM-EPMT. NRM-EPMT decisions about which species to treat are based on consultation with park staff as well as state noxious weed species lists, inventories of park lands, availability of effective control methods, past history of treatment response at the parks, and availability of funding and staffing. Table 3 shows how the parks would continue to determine what species to treat under Alternative 1.

Table 3: Determining What Species to Treat (Alternative 1)

Park Name	How Park Determines What Species to Treat
City of Rocks	Annual treatment priorities of weed populations are based on the importance, location and accessibility of each weed area, the actions/treatments performed the previous year, the type and seasonal growth pattern of each weed, and the availability of both local and EPMT crews. Generally small isolated noxious weed infestations are given the highest priority for treatment.
Craters of the Moon	Annual treatment priorities of weed populations are based on the importance, location and accessibility of each weed area, the actions/treatments performed the previous year, the type and seasonal growth pattern of each weed, and the availability of both local and NRM-EPMT crews. The county noxious weed list and park's invasive species list are used to determine priorities. Generally small isolated noxious weed infestations on NPS lands are given the highest priority for treatment.
Fossil Butte	County Noxious Weed List Park list of exotics Treatment of the most invasive weeds with the most cover.
Golden Spike	NRM-EPMT recommendations State and county noxious weed lists
Grant-Kohrs	NRM-EPMT recommendations and past treatment records / known weed infestations, monitoring plot data, state and county surveys and inventory and monitoring vegetation

Park Name	How Park Determines What Species to Treat
	map.
Hagerman Fossil Beds	NRM-EPMT recommendations
Little Bighorn	State and county noxious weed lists as well as nonnatives visually impacting the historic viewshed and cultural landscape. Annual priorities are determined based on the time and resources needed to treat the species, whether it is a new invader, the size of the infestation, and the visual impact on the cultural landscape.
Minidoka	NRM-EPMT recommendations
Nez Perce: Bear Paw	State and county noxious weed lists.
Nez Perce: Big Hole	State noxious weed list, county recommendations and park list of invasive species.

In Alternative 1, the parks would continue to use multiple sources of information about what species to focus their priorities on. Tables 4-13 show the current priorities for treatment in the 10 parks. For parks that rely on the NRM-EPMT, these lists are based on what the NRM-EPMT has treated since its inception. For other parks, these lists have been developed over time based on factors identified in the table above, including whether or not the plant appears on noxious weed lists, where it is located, how big the infestation is and whether there are current recommended effective means of treating the infestation, as well as on the availability of park and/or EPMT staff and funding.

Table 4: City of Rocks Current High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Spotted knapweed	*Centaurea stoebe*	2004-2009
Diffuse knapweed	*Centaurea diffusa*	2003, 2007
Hoary cress / whitetop	*Cardaria draba*	2006-2009
Scotch thistle	*Onopordum acanthium*	2004-2008
Musk thistle	*Carduus nutans*	2004-2009
Houndstongue	*Cynoglossum officinale*	2006-2008
Poison hemlock	*Conium maculatum*	N/A
Canada thistle	*Cirsium arvense*	2004-2009
Black henbane	*Hyoscyamus niger*	2004-2005
Field bindweed	*Convolvulus arvensis*	2006-2008

NRM-EPMT also treated common mullein (2005-2009), bull thistle (2004-2009), common burdock (2006-2008) and Dalmatian toadflax (2004).

Table 5: Craters of the Moon High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Dyers woad	*Isatis tinctoria*	2007-2009
Leafy spurge	*Euphorbia esula*	2004-2009
Canada thistle	*Cirsium arvense*	2004-2007, 2009
Russian knapweed	*Acroptilon repens*	2004, 2007
Diffuse knapweed	*Centaurea diffusa*	2004-2009
Spotted knapweed	*Centaurea stoebe*	2004-2009
Rush skeletonweed	*Chondrilla juncea*	2005-2009
Scotch thistle	*Onopordum acanthium*	2004-2005
Bull thistle	*Cirsium vulgare*	2003- 2007
Cheatgrass	*Bromus tectorum*	2005
Field bindweed	*Convolvulus arvensis*	N/A
Black henbane	*Hyoscyamus niger*	N/A
Common mullein	*Verbascum thapsus*	2003-2008

Common Name	Scientific Name	NRM-EPMT Treatment
Common burdock	*Arctium minus*	2003-2007
Smooth brome	*Bromus inermis*	N/A
Dalmatian toadflax	*Linaria dalmatica*	N/A
Musk thistle	*Carduus nutans*	N/A
Moth mullein	*Verbascum blattaria*	N/A

NRM-EPMT also treated common tansy (2004), chicory (2003, 2006), and Russian thistle (2003, 2006).

Table 6: Fossil Butte Current High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Black henbane	*Hyoscyamus niger*	2007-2009
Musk thistle	*Carduus nutans*	2006-2009
Bull thistle	*Cirsium vulgare*	2004-2009
Canada thistle	*Cirsium arvense*	2004-2009
Cheatgrass	*Bromus tectorum*	N/A
Clasping pepperweed	*Lepidium perfoliatum*	N/A
Common Mullein	*Verbascum thapsus*	N/A
Smooth brome	*Bromus inermis*	N/A
Spotted knapweed	*Centaurea stoebe*	2004-2009
Yellow sweet clover	*Melilotus offinalis*	2004
Hoary cress / whitetop	*Cardaria draba*	2009
Field bindweed	*Convolvulus arvensis*	2009
Flix weed	*Descurainia Sophia*	N/A
Creeping foxtail / Fountain grass	*Alopecurus arundinaceus*	2003-2004, 2009
Sow thistle	*Sonchus uliginosus*	2007

NRM-EPMT also treated Scotch thistle (2004).

Table 7: Golden Spike High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Common mullein	*Verbascum thapsus*	2004-2009
Dyers woad	*Isatis tinctoria*	2004-2009
Hoary cress / Whitetop	*Cardaria draba*	2006-2008
Saltcedar	*Tamarix ramosissima*	2007-2009
Scotch thistle	*Onopordum acanthium*	2004, 2006-2009
Moth mullein	*Verbascum blattaria*	2006-2009
Field bindweed	*Convolvulus arvensis*	2007-2009

NRM-EPMT also treated bull thistle (2004) and Canada thistle (2004).

Table 8: Grant-Kohrs High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Yellow toadflax	*Linaria vulgaris*	2006-2009
Leafy spurge	*Euphorbia esula*	2005-2009
Canada thistle	*Cirsium arvense*	2004-2009
Spotted knapweed	*Centaurea stoebe*	2004-2009
Cheatgrass	*Bromus tectorum*	2006-2008
Field bindweed	*Convolvulus arvensis*	2004, 2008-2009

Common Name	Scientific Name	NRM-EPMT Treatment
Perennial pepperweed	*Lepidium latifolium*	2005-2009
Hoary cress	*Cardaria draba*	2005-2009
Russian Knapweed	*Acroptilon repens*	2008
Houndstongue	*Cynoglossum officinale*	2009
Common tansy	*Tanacetum vulgare*	2003
Tall buttercup	*Ranunculus acris*	N/A
Sulfur cinquefoil	*Potentilla recta*	N/A
Baby's breath	*Gypsophila paniculata*	2005-2009
Kochia	*Kochia scoparia*	2005-2007

NRM-EPMT also treated common teasel (2006), common mullein (2003-2009), and diffuse knapweed (2008-2009.

Table 9: Hagerman Fossil Beds High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Houndstongue	*Cynoglossum officinale*	2007-2009
Diffuse knapweed	*Centaurea diffusa*	2004-2009
Purple loosestrife	*Lythrum salicaria*	2003-2009
Rush skeletonweed	*Chondrilla juncea*	2004-2009
Saltcedar	*Tamarix ramosissima*	2004-2009
Canada thistle	*Cirsium arvense*	2005-2009
Common teasel	*Dipsacus fullonum*	2003-2006

NRM-EPMT also treated common mullein (2003), puncturevine (2008), sowthistle (2006), Russian thistle (2008), Scotch thistle (2006-2007), bull thistle (2003-2006), Russian olive (2006-2008) and common burdock (2008).

Table 10: Little Bighorn Current High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment	Additional Park Treatment 2005-2009
St. Johnswort	*Hypericum perforatum*	2009	2005-2009
Hoary alyssum	*Berteroa incana*	N/A	N/A
Bulbous bluegrass*	*Poa bulbosa*	N/A	2009
Smooth brome	*Bromus inermis*	N/A	N/A
Kochia	*Kochia scoparia*	N/A	2005-2006, 2009
Houndstongue	*Cynoglossum officinale*	2005	2005-2009
Canada thistle	*Cirsium arvense*	2004-2005	2005-2009
Hoary cress / Whitetop	*Cardaria draba*	2005, 2009	2005-2009
Russian knapweed	*Acroptilon repens*	N/A	2005-2009
Spotted knapweed	*Centaurea stoebe*	2004, 2009	2005-2009
Field bindweed	*Convolvulus arvensis*	2004-2007	2005-2009
Dalmatian toadflax	*Linaria dalmatica*	N/A	2008-2009
Saltcedar, Tamarisk	*Tamarix ramosissima*	2008-2009	2008-2009
Tatarian honeysuckle*	*Lonicera tatarica*	2009	2009
Russian olive	*Elaeagnus angustifolia*	2007-2009	2007-2009
Tumble mustard*	*Sisymbrium altisssimum*	N/A	2005
Flixweed	*Descurainia sophia*	N/A	2005
Curly dock*	*Rumex crispus*	N/A	2005-2008
Bull thistle	*Cirsium vulgare*	2004-2005	2005-2009
Cheatgrass	*Bromus tectorum*	N/A	2005, 2009
Crested wheatgrass	*Agropyron cristatum*	N/A	N/A
Dandelion*	*Taraxacum officinale*	N/A	2005-2009
Prickly Russian thistle	*Salsola tragus*	2004	2005-2007

Common Name	Scientific Name	NRM-EPMT Treatment	Additional Park Treatment 2005-2009
Alfalfa*	*Medicago sativa*	N/A	N/A
Stinkgrass*	*Eragrostis cilianensis*	N/A	N/A
Garden Rhubarb*	*Rheum rhabararum*	N/A	N/A
Black nightshade*	*Solanum nigrum*	N/A	N/A
Clasping pepperweed*	*Lepidium perfoliatum*	N/A	2005-2007

* Species not included in the Alien Plant Ranking System (APRS) database.

NRM-EPMT also treated yellow sweetclover (2005). Park staff also treated prickly lettuce 2007-2008, white clover 2007-2008, and yellow sweetclover 2005-2008.

Table 11: Minidoka Current High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Canada thistle	*Cirsium arvense*	2004, 2006-2009
Bull thistle	*Cirsium vulgare*	2004, 2007
Musk thistle	*Carduus nutans*	2006-2009
Russian knapweed	*Acroptilon repens*	2004-2009
Scotch thistle	*Onopordum acanthium*	2007-2009
Yellow starthistle	*Centaurea solstitialis*	2004-2009
White bryony	*Bryony alba*	2007-2009
Rush skeletonweed	*Chondrilla juncea*	2004, 2007-2009
Common mullein	*Verbascum thapsus*	2006-2009

NRM-EPMT also treated plumeless thistle (2006) and common burdock (2008)

Table 12: Bear Paw Current High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Noxious / Invasive Weeds		
Canada thistle	*Cirsium arvense*	N/A (Treated by Blaine County)
Field bindweed	*Convolvulus arvensis*	N/A
Prickly lettuce	*Lactuca serriola*	N/A
Rush skeletonweed	*Chondrilla juncea*	N/A
Kochia	*Kochia scoparia*	N/A
Escaped from cultivation		
White sweetclover	*Melilotus* sp.	N/A
Yellow sweetclover	*Melilotus officinalis*	N/A
Nonnative species		
Reed canarygrass	*Phalaris arundinacea*	N/A
Curly dock	*Rumex crispus*	N/A

NRM-EPMT also treated spotted knapweed (2004).

Table 13: Big Hole Current High Priority Species

Common Name	Scientific Name	NRM-EPMT Treatment
Noxious / Invasive Weeds		
Spotted knapweed	*Centaurea stoebe*	2004-2009
Canada thistle	*Cirsium arvense*	2004-2009
Field bindweed	*Convolvulus arvensis*	2005-2009

Common Name	Scientific Name	NRM-EPMT Treatment
Common Tansy	*Tanacetum vulgare*	2004-2009
Ox-eye daisy	*Chrysanthemum leucanthemum*	N/A
Hoary alyssum	*Berteroa incana*	2005-2009
Leafy spurge	*Euphorbia esula*	2004, 2007
Bull thistle	*Cirsium vulgare*	2004-2006
Nonnative species		
Yellow sweet clover	*Melilotus officinalis*	N/A
Dandelion	*Taraxacum officinale*	N/A
Mallow	*Malva neglecta*	N/A
Knotweed (prostrate)	*Polygonum sp.*	N/A
Common mullein	*Verbascum thapsus*	2004-2009

4. Conducting Treatments (Current Program)

a) Introduction

In Alternative 1, collectively, the 10 parks rely on all five treatment methods (cultural, manual/mechanical, biological, chemical, and fire) to reduce nonnative plant populations (see the sidebar definitions). Each of the treatment methods would continue to be applied alone or in combination with others as they have been used in the past at the partner parks, as appropriate to control nonnative invasive plants. Individually, most of the parks focus on just three of these methods (cultural, manual/mechanical, and chemical). Grant-Kohrs has used biological control and Craters of the Moon has tested its use. Only Golden Spike has used prescribed fire to control invasive species.

Under Alternative 1, the 10 parks would continue to conduct treatments using the means, methods and programs described below. Both the NRM-EPMT and the parks would continue to use multiple treatment methods, including hand-pulling weeds, burning infested areas, mowing, and spraying. These treatment methods are reviewed and approved annually through the EPMT program and/or the NPS Pesticide Use Proposal (PUP) system (if they involve chemical or biological control).

As noted in the introduction, it is likely that in Alternative 1, these treatments would continue to expand over time as new plants were found and new treatments were identified. Therefore, overall treatments would likely continue to change from year to year depending upon how responsive invasive plants are to treatment methods. Approximately 36 species have been inventoried and/or treated by the NRM-EPMT over the past six years (Table 14: *NRM-EPMT Treatment of Weeds at Northern Rocky Mountains Parks 2004-2009*).

Following the introduction of the five types of treatments used by the partner parks, is a brief summary of invasive plant management treatment at each of the 10 parks. Park and NRM-EPMT actions (2005-2009) are summarized.

INVASIVE PLANT TREATMENT METHODS

Cultural: practices that reduce opportunities for invasive plants to occur and allow for the continued growth and spread of native plants. Examples include using clean fill in construction and seeding native species following disturbance. Grazing to stimulate grasses to prevent invasion is cultural control.

Manual / Mechanical: practices that remove all or part of the invasive plant. Examples include hand-pulling, cutting, grubbing, haying and mowing.

Biological: the practice of using the natural enemies of plants (such as insects and fungi) to control them. Examples include the use of plant feeding insects to control invasive plants. Biological control methods are used only when the agent is host-specific and has a negligible risk of becoming a pest itself. Grazing to target weeds (like GRKO training their cattle to eat knapweed) is an example of biological control.

Prescribed Fire, including Flaming: the practice of using fire, in certain areas, under specific conditions, to control invasive plants. Flaming is using a hand-held torch to remove or burn all or part of a plant. The use of prescribed fire must also be identified in park Fire Management Plans.

Chemical: the practice of applying herbicides according to their approved label uses. Examples of application methods include backpack spraying, spot treatment (stump painting) and aerial application using fixed wing aircraft or helicopters.

Table 14: NRM-EPMT Treatment of Weeds at Northern Rocky Mountains Parks 2004-2009

Weed Species	CIRO	CRMO	FOBU	GOSP	GRKO	HAFO	LIBI	MIIN	BEPA	BIHO
Baby's Breath *Gypsophila paniculata*					2005-2009					
Hoary Alyssum *Berteroa incana*										2005-2009
White Bryony *Bryonia alba*								2007-2009		
Common Tansy *Tanacetum vulgare*		2004			2004					2004-2009
Dyers Woad *Isatis tinctoria*		2007-2009		2004-2009						
Field Bindweed *Convolvulus arvensis*			2004	2004-2009	2004 2008-2009		2004-2007			2005-2009
Cheatgrass *Bromus tectorum*		2005			2006-2009	2006				
Creeping Foxtail *Alopecurus arundinaceus*			2004 2009							
Black Henbane *Hyoscyamus niger*	2004-2005	2004	2004-2009		2009					
Hoary Cress / whitetop *Cardaria draba*	2006-2009	2009	2004 2009	2006-2008	2005-2009		2005-2009	2006		
Houndstongue *Cynoglossum officinale*	2006 2008		2003		2009	2007-2009	2005			
Diffuse Knapweed *Centaurea diffusa*	2007	2004-2009			2008-2009	2004-2009				
Russian Knapweed *Acroptilon repens*	2003 2007	2004-2007			2007-2008			2004-2009		
Spotted Knapweed *Centaurea stoebe*	2004-2009	2004-2009	2004-2009		2004-2009		2004 2009		2004	2004-2009
Kochia *Kochia scoparia*					2005-2007					
Leafy Spurge *Euphorbia esula*		2004-2009			2004-2009					2004 2007
Common Mullein *Verbascum thapsus*	2007-2008	2004-2008		2006-2007	2007-2009			2006-2009		2005-2009
Moth Mullein *Verbascum blattaria*				2006-2008						
Russian Olive *Elaeagnus angustifolia*						2006-2008	2007-2009			
Perennial Pepperweed *Lepidium latifolium*					2005 2009					
Purple Loosestrife *Lythrum salicaria*						2004-2009				
Rush Skeletonweed		2005-2009				2004-2009		2004		

Weed Species	CIRO	CRMO	FOBU	GOSP	GRKO	HAFO	LIBI	MIIN	BEPA	BIHO
Chondrilla juncea								2007-2009		
Saltcedar, Tamarisk *Tamarix ramosissima*				2007-2009		2004-2009	2008-2009			
Bull Thistle *Cirsium vulgare*	2004-2009	2006 2007	2004-2009	2004		2006-2009	2004-2005	2004 2007		2004-2006
Canada Thistle *Cirsium arvense*	2004-2009	2004-2007 2009	2004-2009	2004	2004-2009	2005-2009	2004-2005	2004-2009	2009 (park staff)	2004-2009
Musk Thistle *Carduus nutans*	2004-2009		2004-2009					2006-2009		
Scotch Thistle *Onopordium acanthium*	2004-2008	2004-2007		2004-2009		2006-2007		2007-2009		
Yellow Starthistle *Centaurea solstitialis*								2004-2009		
Dalmatian Toadflax *Linaria dalmatica*	2004									
Yellow Toadflax *Linaria vulgaris*					2006-2009					
Yellow Sweetclover *Melilotus officinalis*			2004				2005			
Fountaingrass *Alopecurus arundinaceus*			2009							
Common Teasel *Dipsacus fullonum*						2006				
Bush honeysuckle *Lonicera tatarica*							2009			
St. Johnswort *Hypericum perforatum*							2009			
Prickly Russian thistle *Salsola tragus*							2004			

(NPS 2003a, 2004a, 2005a, 2006a, 2007a, 2008a, 2009a)

b) Types of Treatments

The following types of cultural, manual / mechanical, biological, chemical and prescribed fire treatments at the partner parks would continue in Alternative 1. In general, treatments are most effective when applied before seeds are released, but depending on the type of plant, one treatment may be better than another. For example, sometimes chemical treatments work better on plants that spread from rhizomes, or resprout from roots compared to manual / mechanical treatments. Treatments that cause the least disturbance are preferred because disturbance creates conditions ideal for reinvasion or invasion by new nonnative invasive species.

1) Cultural Treatments

Cultural treatments are practices that promote the growth of desirable plants. Cultural treatments may suppress existing weeds; prevent new infestations; or prevent or reduce the reestablishment of weeds after other treatment methods (mechanical or chemical) have eradicated or reduced an infestation. Examples include restoration such as seeding or planting native plants, and other methods such as irrigation or mulching. Other examples include grazing at specific times of the year to enhance competition of grasses. Grant-Kohrs could also use smothering crops (when maintained in dense stands, some crops and some native plants are vigorous enough to keep weeds in check). In addition, competitive planting, such as at Grant-Kohrs (some forage and small grain crops, perennial grass sods, most agronomic row crops and some horticultural crops can provide heavy competition if managed correctly); crop rotation and the use of allelopathic plants that produce chemical substances that inhibit undesirable species or stimulate the growth of desirable competition are other cultural methods to treat nonnative invasive species.

The following cultural treatments have been implemented and would continue to be used by the partner parks:

- Revegetation / Restoration

Restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed (SER 2002 in NPS DINO 2005). Damage or degradation in this context refers to the presence of weeds, while the establishment of desirable native vegetation is the recovery. Assisting the establishment of desirable vegetation through revegetation practices contributes to the larger goal of restoration as well as the goal of weed management (Jacobs *et al.* 1998 in NPS DINO 2005). The establishment of a diverse community of desirable vegetation can prevent weed encroachment by utilizing all or most available resource niches (Sheley *et al.* 1996 in NPS DINO 2005). Revegetation practices include seedbed preparation, broadcast seeding, drill seeding, container planting and planting live branches of species that readily root, such as willows or dogwood (Roundy 1996 in NPS DINO 2005).

In addition to being a prevention technique, reseeding and revegetation can be a cultural treatment to augment or encourage the growth of native plants and to prevent the growth of nonnative plants. This technique is currently used by some of the 10 parks. For example, seed collection from native plants in an area to be disturbed is usually used in concert with construction projects. Revegetation or reseeding is particularly useful, where an opportunistic invasive plant has invaded a small area of disturbance in an otherwise intact native plant community and where revegetation would easily reestablish the native plant community composition under existing site conditions. When selecting species for seed mixtures for revegetation, resource managers rely on surrounding native vegetation wherever possible. When this is not possible, a native mixture that includes some species with rapid seedling growth, shading capabilities or tolerance, and that produces seed within the first or second year is recommended.

Upon effective control or in combination with other treatments, the 10 parks would continue to employ restoration in treated areas. Restoration of native ecosystems is the ultimate goal of invasive plant management. In some areas, recovery of native ecosystems may occur naturally over time following the removal of invasive species. In many areas, however, active restoration efforts may be needed following treatment of nonnative plant species to inhibit re-invasion by the same or other nonnative species and/or

to facilitate faster recovery in some habitats. Some areas may not recover at all without active restoration (such as seeding and planting).

- Irrigation

Irrigation has been used by the partner parks, usually on a limited basis during the dry season, in combination with reseeding (hydromulching) or revegetation. Irrigation is critical at Little Bighorn in the Custer National Cemetery to maintain a healthy turf free of broadleaf species. During severe drought years (2004-2005), the Cemetery became infested with field bindweed, because the well system could not produce enough water.

- Fertilizing

Fertilizer can enhance the growth of the existing community, especially when it is predominantly grasses, and allow it to out-compete the invasive species (Jacobs and Mangold 2008). The type, the time of year, the amount, the type of application and the target invasive plant species must all be taken into account when applying fertilizer to a given area. Applying sucrose to tie up nitrogen has been used experimentally to favor native plants and to reduce cheatgrass (Perry *et al.* 2010). Used incorrectly, however, fertilizer can favor invasive species over native species.

- Grazing

Grazing may be considered either biological control (see below) or a cultural technique. If grazing is used, short intense periods are usually the most effective for natural areas. A solid understanding of forage versus weed biology is also important to determine appropriate grazing intervals. In Alternative 1, grazing is primarily employed by Grant-Kohrs as an invasive plant management technique; however, grazing and/or stock trailing also occur in City of Rocks, Craters of the Moon, Fossil Butte and Little Bighorn.

2) Manual / Mechanical Treatments

In Alternative 1, the 10 partner parks would continue to use manual / mechanical treatments, either on their own or as part of the NRM-EPMT implementation of invasive plant removal. Manual and mechanical treatments involve physical damage to or removal of all or part of a plant.

Manual treatments include hand-pulling and bagging of seed heads and other removal of invasive plants or plant parts by hand, such as cutting. Manual treatment, such as hand-pulling, is most effective on shallow- and tap-rooted species and best conducted when soils are moist. In the partner parks manual treatments have been used on spotted knapweed, dyers woad, Dalmatian toadflax, thistles (Canada, bull, musk, and Russian), mullein, burdock, cheatgrass, and leafy spurge, and other limited populations of some nonnative species. (*Note: Hand-pulling of Canada thistle has since been discontinued because it promotes heavier growth rather than control.*)

Mechanical treatments include the use of hand and power tools and may also include the use of heavy equipment to remove plants or plant parts. Some examples of tools include: shovels, pulaskis, loppers, weed wrenches, weed whips, mowers, hand-saws, chainsaws, pruners, mowers, tractors, plows or discs, and heavy equipment, such as bulldozers or loaders. Cutting is usually most effective to remove seedheads on biennial plants and for large woody species, such as brush and trees. Mowing is most effective for invasive species that respond to it by reduced growth or vigor and where the invasive species is growing in large flat areas and no sensitive resources would be affected by its use. Mowing is also most appropriate when the native plant community is mostly grasses (compared to native forbs, which typically do not respond well to mowing). Weed whips can be used like mowing in rocky areas. Pulling tools, such as weed wrenches, are effective to dislodge deeply rooted species and are most effective in firm soils. Removal of aboveground portions of plants often helps to contain the spread of a population by reducing its vigor and/or growth. When conducted repeatedly before seed set, mechanical removal can reduce populations of some species. Because of the disturbance caused by use of heavy equipment, this type of mechanical treatment is generally limited to areas of dense, single-species infestations of woody plants, where few or no natural or cultural resources and no sensitive sites or species are otherwise present.

Biological Control or Biocontrol

Biocontrol can be an effective method to control some species. Biological control, or biocontrol, involves the introduction of herbivores or pathogens, such as insects or fungi, which infest invasive species and reduce their ability to persist and produce seeds. An effective biological control agent introduced to attack invasive plant populations must be highly host specific. In other words, the control agent must only affect the target plant and show little or no affinity for native species that may be closely related to the invasive plant. As a result, biological control agents undergo rigorous laboratory and field-testing by the Department of Agriculture and the states before they are approved for use in agricultural or natural settings.

Biocontrol has been used extensively to control some invasive plant species in North America. Flea beetles (*Aphthona lacertosa* and *Aphthona nigriscutis*) have been used to reduce leafy spurge (*Euphorbia esula*) in California and many other states (National Invasive Species Council 2001). The beetle *Chrysolina quadrigemina* has been introduced to control populations of St. Johnswort (*Hypericum perforatum*) (Harris 1988 in NPS YOSE 2008). The peacock fly (*Chaetorellia australis*), the hairy weevil (*Eustonopus villosus*), and the false peacock fly (*Chaetorellia succinea*) have been used to control yellow star thistle in Yosemite National Park (NPS YOSE 2008).

Some examples of mechanical treatments in the partner parks include mowing pastures before seed-set at Grant-Kohrs, cutting of seed heads at Craters of the Moon, digging and pulling of tap-rooting species, such as houndstongue and bull thistle at Little Bighorn, and tamarisk and Russian olive tree removal at Hagerman Fossil Beds, Little Bighorn and Golden Spike.

Other manual / mechanical treatments include: hand hoeing, cutting, tillage, flooding and heat (solarization or steam), spudding (severing of roots below the root crown), and smothering.

Manual / mechanical treatments are most often used on non-rhizomatous plants and may have to be implemented more than once each season, depending on the stage of the plant / plant population at the time of initial removal. In many cases, to be most effective, manual / mechanical treatment must be conducted at the right stage of a plant's life history (phenology). Manual / mechanical treatments are often used in combination with other treatments, such as chainsaw removal of tamarisk, followed by stump painting with an herbicide to prevent resprouting; or cutting of Japanese knotweed, allowing it to regrow, then spraying the resprouts with herbicide; or clipping seedheads from Canada thistle, then treating with herbicide later in the fall during peak times of translocation to the roots.

3) Biological Control Treatments

Biological control treatment or biocontrol is the use of natural enemies, such as insects and microorganisms or livestock, to reduce the abundance of a nonnative species. Natural enemies of target nonnative plants, such as insects, are imported from the area where the nonnative plant exists as a native species. The insects are then deliberately released into the area where the species occurs as a nonnative plant. For insects and other biocontrol microorganisms, APHIS, part of the USDA is the agency responsible for researching and approving the use of these biocontrol agents in the United States. All biological control insects and microorganisms used by parks for management of nonnative invasive plants are approved by APHIS. Prior to approval by APHIS, biological control agents have undergone extensive testing to ensure that the agent is host-specific and does not affect similar native species and that the agent has a negligible risk for becoming a pest itself.

Biological control agents must also be approved by the NPS. Under *Management Policies* (NPS 2006):

> *The application or release of any bio-control agent or bioengineered product relating to pest management activities must be reviewed by designated IPM specialists in accordance with Director's Order #77-7 and conform to the exotic species policies in section 4.4.4 (NPS 2006: Section 4.4.5.4).*

Under NPS-77, the Natural Resources Management Guideline:

> *Review and Approval to Use Biological Control Agents: Any park proposing to release a biological control agent must receive approval from the Regional or National IPM Coordinator. Biological control use requests are first submitted to the Regional IPM Coordinator. The Regional IPM Coordinator may deny the proposal, modify the proposal in cooperation with the park and forward the modified request, or forward the request (without modification) to the National IPM Coordinator*

for review and approval. State permitting may also be required prior to the release of a biological control agent (NPS 1991).

Table 15 shows the insect biological control agents that have been approved by APHIS for Pacific West or Intermountain region parks. Only those indicated have actually been used in a park unit.

Biological controls can be imported or inoculated. To be effective, they must possess certain characteristics, not only the ability to reduce a weed population to nondestructive levels, but also to avoid harm to desirable plants, reproduce quickly, be able to survive and maintain a population equilibrium, and be adapted to the environment of the host plant. Some biological agents are disease organisms or insects that are grown to artificially increase the population size. Other biological agents come from conserving natural enemies of target plants.

The success of biological control is often dependent on the ability of other nearby plants to invade the treated site. Generally biological controls do not eradicate a targeted species, but often put enough direct pressure on it that the species expansion is slowed or the plants lose vigor. At this point, another method may be successful in controlling or eradicating the plant.

Currently, insect biological controls are available for the following species: purple loosestrife, leafy spurge, knapweeds (Russian, spotted, diffuse, and squarrose), rush skeletonweed, Dalmatian toadflax, yellow toadflax, tansy ragwort, yellow starthistle, St. Johnswort, field bindweed, puncture vine, Scotch broom, rush skeletonweed, and thistles, including musk thistle. Research is ongoing, so this list is likely to expand through time. Effectiveness of the control, however depends on the biological control and the target species as well as the terrain, and weed density.

Grant-Kohrs Ranch used biological control in the 1990s to treat populations of spotted knapweed. At both Grant-Kohrs Ranch and Craters of the Moon, biological controls (released on adjacent lands) have been observed to be affecting invasive weed populations (see b): *Types of Treatments* in this section). In 2008, Craters of the Moon cooperated with Rocky Mountain Research Station (Bozeman, Montana) to allow research on an approved insect for rush skeletonweed. The insect is approved, but more research is needed to assess requirements for establishment.

In some cases, livestock (primarily cattle, geese, goats and sheep) are also used in controlled situations as biocontrol agents to reduce the abundance of a species by eating it. In other areas, the BLM has used goats to successfully control infestations of leafy spurge at a lower cost than chemical control methods (BLM 2007a in BLM 2009). Grant-Kohrs Ranch successfully tested the use of cattle to eat target weed species by cooperating with researchers from Utah State University. In this study, which occurred over two years (2004-2005), park and university staff trained cows to eat spotted knapweed, Canada thistle, and some leafy spurge through a systematic program of weed collection and the introduction of the weeds into the cow's regular diet and then observed the results of the conditioning (http://www.livestockforlandscapes.com/grko.htm). The program was successful. Once the cows had eaten the target weeds regularly in controlled feedings, they were observed to be eating the weeds in pasture grazing.

As a result of the above program, observations have shown that cattle trained as part of the program have continued to eat the target weeds. If possible, given staffing and funding, Grant-Kohrs would continue to implement this program in Alternative 1. Because it has been a few years since the program was fully implemented, Grant-Kohrs is now beginning a study to determine whether the cows that participated in the program have passed on the learned behavior of eating the target weeds to their offspring and/or to other herd animals as was expected by the research thesis.

Table 15: Biological Control Agents That Have Been or Could Be Used in Pacific West and Intermountain Region Parks

Note: APHIS approved species for biocontrol change frequently. This is not intended as a comprehensive list, but an overview of species available in ID, MT, UT and/or WY at the time of this publication.

Insect Latin Name	Common Name	Plant Common Name(s)	Park Unit*	Comments
Aceria malherbae	Bindweed gall mite	Field bindweed		
Tyta luctuosa	Bindweed moth	Field bindweed		
Agapeta zoegana	Root boring moth	Diffuse and spotted knapweeds, occasionally squarrose knapweed		
Bangasternus fasuti	Broad-nosed seed head weevil	Diffuse, spotted, and squarrose knapweeds		
Chaetorellia acrolophi	Seedhead fly	Diffuse and spotted knapweeds, occasionally squarrose knapweed		
Cyphocleonus achates	Root boring weevil	Diffuse and spotted knapweeds	GRKO	
Larinus minutus/ obtusus	Lesser knapweed and blunt knapweed flower weevil	Diffuse, spotted, meadow, and squarrose knapweed	GRKO	
Metzneria paucipunc-tella	Spotted knapweed seed head moth	Diffuse, spotted and meadow knapweed		
Sphenoptera jugoslavica	Bronze knapweed borer	Diffuse (preferred), spotted, and squarrose knapweeds		
Subanguinea picridis	Russian knapweed gall nematode	Russian knapweed		
Urophora affinis	Banded gall fly	Diffuse, spotted, and squarrose knapweed	GRKO (suspected)	
Urophora quadrifasciata	UV knapweed seed head fly	Diffuse, spotted, and squarrose knapweeds	GRKO (suspected)	
Bangasternus orientalis	Starthistle bud weevil	Yellow starthistle		
Chaetorellia succinea	False peacock fly	Yellow starthistle		
Eustenopus villosus	Starthistle hairy weevil	Yellow starthistle		
Larinus curtus	Starthistle flower weevil	Yellow starthistle		
Urophora sirunaseva	Starthistle gallfly	Yellow starthistle		
Apthona cyparissiae	Brown dot leafy spurge beetle	Leafy spurge		
Apthona flava	Copper or amber leafy spurge flea beetle	Leafy spurge		
Aphthona lacertosa/czwalinae	Brown legged leafy spurge flea beetles	Leafy spurge	GRKO	
Aphthona nigriscutis	Leafy spurge flea beetles	Leafy spurge	GRKO	
Hyles euphorbiae	Leafy spurge hawk moth	Leafy spurge	GRKO	
Oberea erythrocephela	Red headed spurge stem borer	Leafy spurge	GRKO	
Rhizoctonia sp.	Soil borne fungi	Leafy spurge		
Spurgia esulae	Spurge shoot-tip gall midge	Leafy spurge		
Phyrdiuchus tau	European crown boring weevil	Mediterranean sage		
Microlarinus lareynii, M. lypriformis	Puncturevine seed weevil	Puncture vine		
Galerucella calmaeriensis	Black margined loosestrife beetle	Purple loosestrife		
Galerucella pusilla	Golden loosestrife beetle	Purple loosestrife		
Hylobius transversovittatus	Loosestrife root weevil	Purple loosestrife		
Nanophyes marmoratus	Loosestrife seed weevil	Purple loosestrife		
Bruchidius villosus	Scotch broom bruchid	Scotch Broom		
Exapion fuscirostre	Scotch broom seed weevil	Scotch Broom		
Leucoptera spartifoliella	Scotch broom twig miner	Scotch Broom		

Insect Latin Name	Common Name	Plant Common Name(s)	Park Unit*	Comments
Bradyrrhoa gilveolella	root moth	Rush skeletonweed	CRMO (released with USFS Rocky Mtn Research Station to study establishment)	This species was approved in 2002, but establishment is poor. Research at CRMO is designed to address this.
Cystiphora schmidti	gall midge	Rush skeletonweed		
Eriophyes chondrillae (formerly *Aceria chondrillae*)	gall mite	Rush skeletonweed		
Puccinia chondrillina	a rust	Rush skeletonweed		
Agrilus hyerici	St. Johnswort root borer	St Johnswort		
Aplocera plagiata	a moth (no commonly accepted common name)	St Johnswort		
Chrysolina hyperici, C. quadrigemina	a moth (no commonly accepted common name)	St Johnswort		Minor feeding on a native and ornamental *Hypericum* in California.
Zeuxidiplosis giardi	gall midge	St. Johnswort		Established in California and Hawaii only
Longitarsus jacobaeae	root feeding flea beetle	Tansy ragwort		
Pegohylemyia senecialla (aka *Botanophila seneciella)*	Seedhead fly	Tansy ragwort		
Tyria jacobaeae	Cinnabar moth	Tansy ragwort		May severely defoliate *Senecio triangularis* (native), and the ornamental dusty miller (*S. bicolor*).
Ceutorhynchus litura	Canada Thistle stem weevil	Canada thistle		
Cheilosia cordyon	Thistle stem hover fly	Bull, musk, and plumeless thistles		Except for OR, establishment is poor.
Rhinocyllus conicus	Thistle-head weevil	Plumeless, musk, and Canada thistles		Found to feed on native thistles. Has been withdrawn from approval.
Trichosirocalus horridus	Musk thistle crown weevil	Plumeless, musk, Canada, and bull thistles		Found to feed on native thistles. Has been withdrawn from approval.
Urophora cardui	Canada thistle stem gall fly	Canada thistle		
Urophora stylata	Bull thistle seed head gall fly	Bull thistle		
Brachypterolus pulicarius	Toadflax flower-feeding beetle	Dalmatian and yellow toadflaxes	GRKO	
Calophasia lunula	Toadflax moth	Dalmatian and yellow toadflaxes		
Gymnetron antirrhini	Toadflax seed capsule weevil	Yellow toadflax	GRKO	
Gymnetron linariae	Toadflax root-galling weevil	Dalmatian toadflax		
Mecinus janthinus	Toadflax stem weevil	Dalmatian and yellow toadflax		
*Indicates a park where biocontrols were released, or have migrated onto the site from off-site releases.				