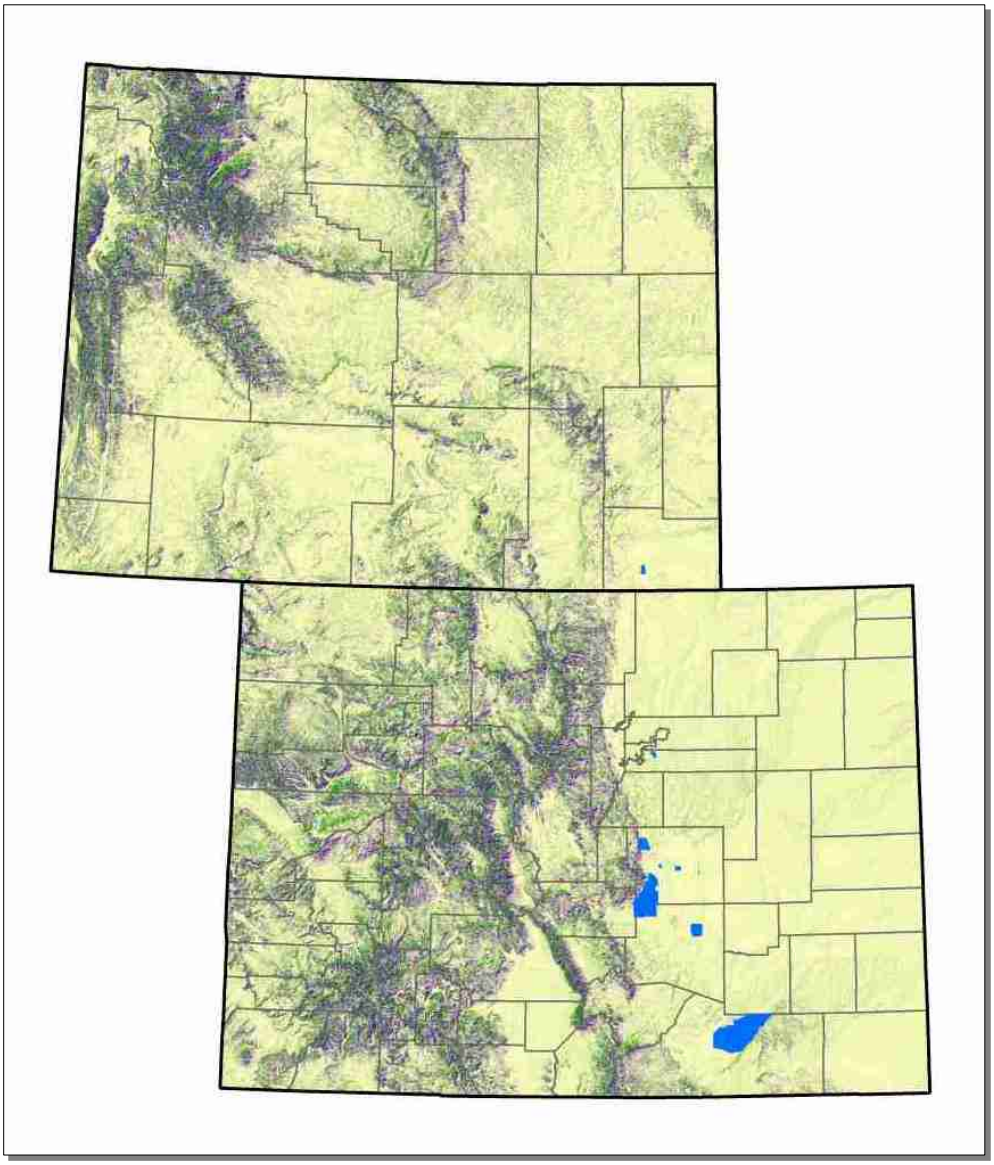
Front Range Eco-regional Partnership
Invasive Plant Species Strategic Plan

June 29, 2007



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Knowledge to Go Places

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Executive Summary

This report details a strategy for control of invasive plants found at nine military installations located along the Front Range of Colorado and Wyoming: Buckley Air Force Base (3,800 acres), Cheyenne Mountain Air Force Station (519 acres), Fort Carson Military Reservation (137,404 acres), Francis E. Warren Air Force Base (5,866 acres), Peterson Air Force Base (1,294 acres), Pinon Canyon Maneuver Site (235,896 acres), Pueblo Chemical Depot (23,000 acres), Schriever Air Force Base (3,840 acres), and the U. S. Air Force Academy (19,107acres). Invasive plant species control plans have been written for six of the nine installations (all except for Pueblo Chemical Depot, Pinon Canyon, and Fort Carson). These plans suggest which weeds are top priorities for control at each installation. They also have specific on-the-ground control recommendations for each noxious weed species that has been documented at the installation. They detail a combination of control options including pulling, mowing, cutting, burning, using biological control methods with insects/pathogens, grazing, and using herbicides. We gathered similar information as available for Pueblo Chemical Depot, Pinon Canyon, and Fort Carson from natural resource personnel at these installations. All nine installations were able to provide at least some mapped locations of noxious weeds to use in this analysis and strategic plan development.

This strategy is not intended to replace the invasive species control plans that have already been detailed. Rather, our goal was to determine region-wide priorities for invasive plant species control on the Front Range military installations related to protecting significant natural resources. To this end, we reviewed noxious weed and other natural resource information available for all nine installations, and considered: invasiveness of the weed species, severity of the infestation, feasibility of control, and location of the infestation (e.g., proximity to significant natural resources). In general, the highest priority was assigned to the most invasive species, smallest infestations, infestations that are easiest to control, and those located in close proximity to areas with important natural resources. Results are summarized in Table 1.

The U.S. Department of Defense (DoD) is responsible for conforming to federal and state noxious weed statutes, and to county weed management plans that are summarized herein. The DoD also has the opportunity to manage lands under their jurisdiction in ways that provide refuge for important natural resources. In all cases, the highest priority weed infestations on the Front Range military installations are found in areas that support important natural resources. It is therefore extremely important that weeds are controlled with careful thought and consideration given to the natural systems present at the weed locations. To assure the long-term survival of the important natural resources present on the Front Range military lands, the DoD will need to look beyond the goal of weed control per se, to the goal of restoring natural communities and native plant and animal populations. A sustained, long-term effort consisting of several complementary approaches will be necessary to abate the threat of noxious weed invasions to the natural resources managed by the DoD.

Table 1. Regional priority level for all noxious weeds found on the nine Front Range military installations. Each species is assigned a regional priority level (very high, high, medium, low, or very low) at each installation based on the invasiveness of the weed species, severity of the infestation, feasibility of control, and the proximity of the infestation to important natural resources. These priority assignments are not meant to replace the individual installation control plans (Carpenter et al. 2004, North Wind 2005b-f). Please note that some species may fall into more than one column.

Installation	**Very high:** most difficult to control AND intersection with high priority or numerous natural resources	**High:** relatively easy to control OR small infestation, AND/OR intersection with important natural resources	**Medium:** easy to control OR small infestation, OR intersection with important natural resources	**Low:** difficult to control OR large infestation, AND/OR no intersection with important natural resources	**Very low:** additional information is needed about infestation AND/OR intersection with important natural resources
Buckley AFB	none	none	Diffuse knapweed, Spotted knapweed, Canada thistle, Dalmatian toadflax, Leafy spurge, Russian olive	Cheatgrass, Musk thistle, Saltcedar, Yellow toadflax, Field bindweed, Redstem filaree	Jointed goatgrass, Scotch thistle, Common mullein
Cheyenne Mountain AFS	none	Plumeless thistle, Russian olive, Saltcedar	Cheatgrass, Musk thistle, Canada thistle, Bull thistle, Field bindweed	none	none
Fort Carson	Spotted knapweed at intersections with rare species and significant plant associations. Myrtle spurge.	Cheatgrass, Musk thistle, Canada thistle, Field bindweed, and Dalmatian toadflax all at intersections with rare species and significant plant associations. Chinese clematis, Difuse knapweed, Russian olive, Yellow toadflax	Spotted knapweed, Cheatgrass, Musk thistle, Canada thistle, Field bindweed, and Dalmatian toadflax where they do not threaten the rare species and plant associations. Saltcedar, Common teasel, Bouncingbet	Common burdock, Common mullein, Common St. Johnswort, Houndstongue, Jointed goatgrass, Redstem filaree, Puncturevine	none
Francis E. Warren AFB	Canada thistle, Dalmatian toadflax, and Leafy spurge, all at rare species locations.	Purple loosestrife (for monitoring), Musk thistle, Houndstongue	Field bindweed, Hoary cress	Canada thistle, Leafy spurge, Dalmatian toadflax	none
Peterson AFB	Purple loosestrife (for monitoring)	Russian olive, Canada thistle	Bull thistle, Common St. Johnswort, Yellow toadflax, Saltcedar, and Puncturevine	Field bindweed	none
Pinon Canyon Maneuver Site	African rue, Russian knapweed	Russian olive outside Cantonment area. Saltcedar , Canada thistle, Hoary cress	Cheatgrass in areas that support significant plant communities. Bull thistle, Field bindweed	Russian olive inside the Cantonment area. Musk thistle, Redstem filaree, Black henbane	Puncturevine, Common burdock, Common mullein, Poison hemlock
Pueblo Chemical Depot	Russian olive, Salt cedar at specific occurrences that mention the problem.	Canada thistle, Saltcedar at other rare species and significant community occurrences	Cheatgrass, Chicory, Field bindweed, Fuller's teasel, Saltcedar, Common mullein	Puncturevine, Quackgrass	Bull thistle, Poison hemlock
Schriever AFB	none	Field bindweed, Canada thistle and Russian olive, all at intersections with significant plant association.	Musk thistle, Diffuse knapweed, Spotted knapweed, Puncturevine.	Field bindweed, Canada thistle and Russian olive, where they do not threaten the signigicant plant association. Cheatgrass.	none

Installation	**Very high:** most difficult to control AND intersection with high priority or numerous natural resources	**High:** relatively easy to control OR small infestation, AND/OR intersection with important natural resources	**Medium:** easy to control OR small infestation, OR intersection with important natural resources	**Low:** difficult to control OR large infestation, AND/OR no intersection with important natural resources	**Very low:** additional information is needed about infestation AND/OR intersection with important natural resources
U. S. Air Force Academy	Myrtle spurge, Spotted knapweed, Leafy spurge	Common St. Johnswort, Russian olive, and Russian knapweed for elimination. Hoary cress, Musk thistle, Diffuse knapweed, Canada thistle, and Fuller's teasel for elimination at intersection with important natural resources, containment elsewhere. Yellow toadflax for suppression/reduction at intersection with important natural resources. Saltcedar for monitoring.	Bull thistle, Scotch thistle	Cheatgrass, Field bindweed, Common mullein, Chicory, Common burdock, Quackgrass, Redstem filaree	Wild proso millet, Bouncingbet, Poison hemlock

Introduction

The purpose of this project is to develop a Strategic Plan for the control of invasive plant species on military installations along the Front Range of the Rocky Mountains in Colorado and Wyoming. The project rolls up goals and objectives from individual installation invasive species control plans and prioritizes control efforts by species and specific infestations in the context of protecting significant natural resources. The primary goal of this strategy is to identify the most critical 10-15 weed infestations in need of control at the Front Range military installations and to facilitate developing a regional strategy to encourage an efficient approach to natural resource and noxious weed management involving sharing knowledge, tools, and expertise across the Front Range region. The strategic plan is coordinated with the counties and states where the installations occur. For the purposes of this report, we focus primarily on invasive plant species that are legally designated "noxious weeds". "Noxious weeds" are non-native plant species which have been designated for mandatory control by local, state, or federal government because of the harm that they are capable of inflicting upon the resources and values of society (Lane 2001). We also provide information about other non-native plants found on the installations as available.

Weed control is important because:

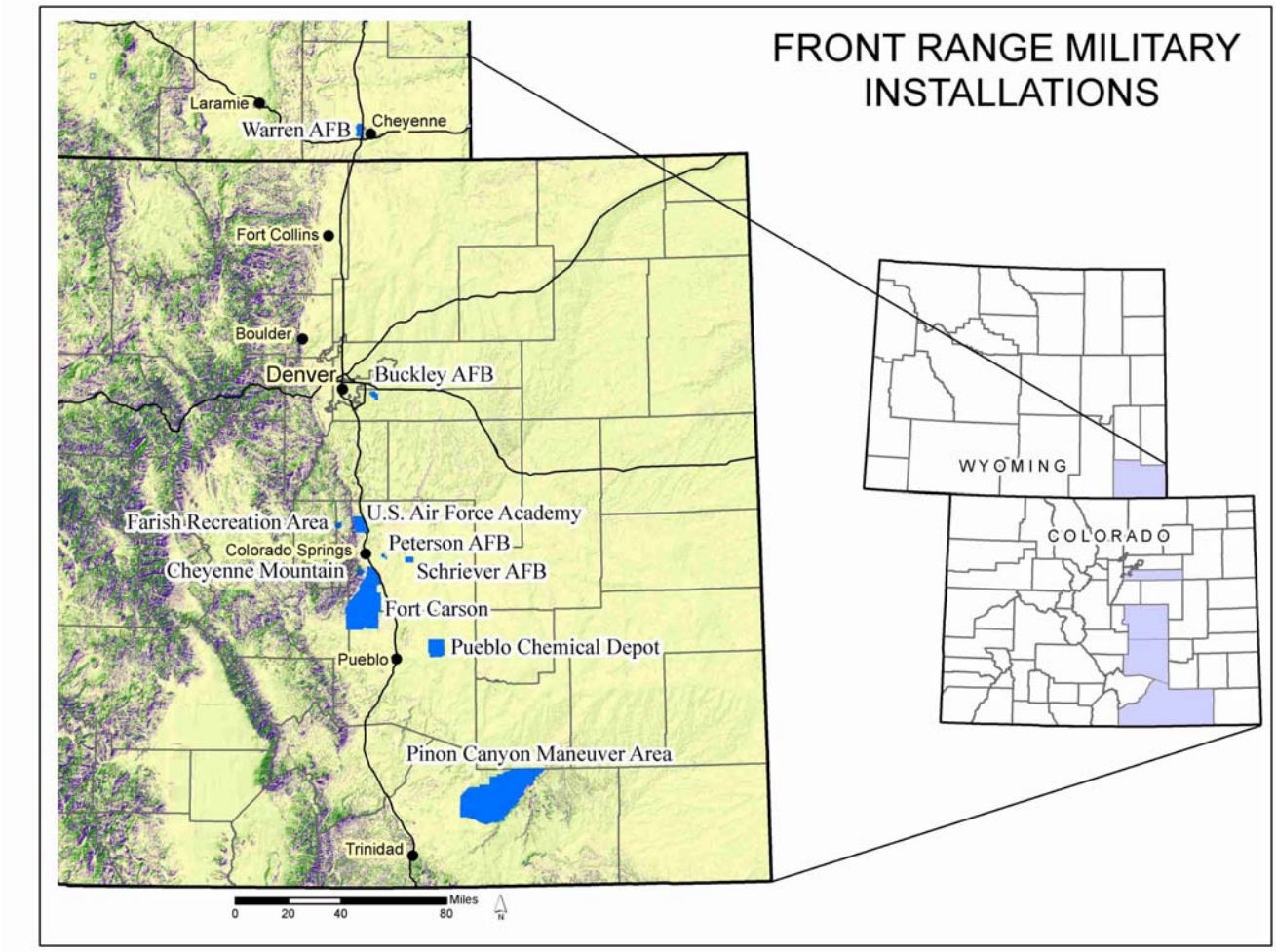
1. Noxious weeds are known to alter ecosystem processes, degrade wildlife habitat, and reduce biological diversity (Sheley and Petroff 1999, e.g., weeds out-compete native plants for water and other resources, weeds can alter fire regimes, etc.)
2. Noxious weeds impact natural resource management activities (e.g., soil erosion control, wetland protection, wildlife management, fire management, endangered species management, etc.)
3. Weeds affect the military's ability to do their work (e.g., training activities)
4. Weed infestations can result in a number of economic impacts (Sheley and Petroff 1999)

We hope that this report provides information that is useful to decision-makers and resource managers to help support effective science-based management of harmful non-native plant species.

Installations:

Buckley AFB (3,800 acres)
Cheyenne Mountain AFS (519 acres)
Fort Carson (137,404 acres)
Francis E. Warren AFB (5,866 acres)
Peterson AFB (1,294 acres)
Pinon Canyon Maneuver Site (235,896 acres)
Pueblo Chemical Depot (23,000 acres)
Schriever AFB (3,840 acres)
U. S. Air Force Academy (19,107acres)

Figure 1. Map of all installations



Background Information

There are a variety of federal, state, and local laws or regulations regarding noxious weed control in the Front Range of Colorado and Wyoming.

Sikes Act

The Sikes Act (16 USC 670a-670o, 74 Stat. 1052, Public Law 86-797 as amended) of 1960 provides for cooperation by the Departments of the Interior and Defense with appropriate State agencies "to promote effectual planning, development, maintenance, and coordination of wildlife, fish, and game conservation and rehabilitation in military reservations." The emphasis on conservation of natural resources on military reservations lays the framework for Department of Defense control of noxious weeds, in context with subsequent legislation.

Federal Noxious Weed Act

The Federal Noxious Weed Act of 1975 (Public Law 93-629 7 U.S.C. 2801 et seq.; 88 Stat. 2148) established a Federal program to control the spread of noxious weeds. Section 1453 of the 1990 Farm Bill (Public Law 101-624) added Section 15 to the Act establishing provisions for the management of undesirable plants on Federal lands. Undesirable plant species are defined as "plant species that are classified as undesirable, noxious, harmful, exotic, injurious, or poisonous pursuant to State or Federal law." Undesirable species cannot include federally listed threatened or endangered species or species indigenous to the area in question.

Where state or private programs for the control of noxious weeds exist, federal land-managing agencies are required to:

1. Designate an office or person adequately trained in managing undesirable plant species to develop and coordinate a program to control such plants on the agency's land;
2. Establish and adequately fund the undesirable plant management program through the agency's budget process.
3. Complete and implement cooperative agreements with the States regarding the management of undesirable plants on agency land. These agreements shall prioritize and target the undesirable plant species to be controlled or contained, describe the integrated management system to by used in control or containment, define the means of implementation, define the duties of the respective agencies, and establish a timeline for completion of the plan.
4. Establish integrated management systems to control or contain undesirable plants targeted under the cooperative agreements. Such integrated management systems shall use an interdisciplinary approach that includes participation by experienced federal or state agency personnel and consideration of the most efficient and effective method of containing or controlling the undesirable plant species, scientific evidence and current technology, the physiology and habitat of a plant species, and the economic, social, and ecological consequences of implementing the program.

Executive Order 13112

Executive Order 13112, signed in February 1999, directed Federal agencies to identify agency actions that may affect the status of invasive species, and, as applicable, to (underlining for emphasis added):

1. prevent introduction of invasive species;
2. detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;
3. monitor invasive species populations accurately and reliably;
4. provide for restoration of native species and habitat conditions in ecosystems that have been invaded;
5. conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and
6. promote public education on invasive species and the means to address them.

Federal agencies are further forbidden to authorize, fund, or carry out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions. The Executive Order also created an Invasive Species Council and an Invasive Species Advisory Committee to provide national leadership on invasive species issues and to develop a nation-wide Invasive Species Management Plan.

U.S. Army Regulatory Requirements

Army Regulation AR 200-3 (Natural Resources - Land, Forest, and Wildlife Management, as modified in 2000) covers policy, procedures, and responsibilities for the conservation, management, and restoration of military land and its natural resources. Section 2-18 of this regulation requires that "objectionable plant growth" be controlled through an Integrated Pest Management program. Plants designated as noxious by Federal or State agencies are to be controlled according to Installation Pest Management Plans (IPMP) under the approval and oversight of the major Army command (MACOM), and in harmony with local community programs and adjacent property owners. The MACOM and the installation natural resource and pest management professionals are responsible for technical supervision and monitoring of the weed control program. IPMPs are to include techniques that take into consideration land use plans, long term cost effectiveness, threatened and endangered species protection, and other environmental impacts. Available approaches include specified mowing heights, turf selection, plant growth regulators, grazing, and use of Environmental Protection Agency (EPA) registered and approved herbicides. Detailed regulations concerning policies to protect health, property, and natural resources from damage by insects, weeds, and other species are provided in Army Regulation 200-5 (superseding AR 420-76). This regulation also details procedures for the storage, handling, and application of herbicides, and the recording and reporting of their use.

The DoD has also developed Measures of Merit (DoD Instruction 4157.7) that attempt to restrict chemical usage, including herbicides, to an average of the level of active ingredient used on a given base in 2002 and 2003 (Mihlbachler personal communication 2006).

Colorado Noxious Weed Act

In 1990, the Colorado General Assembly passed House Bill 90-1175, adding article 5.5 (Undesireable Plant Management) to Title 35 of the Colorado Revised Statutes. Originally known as the "Colorado Weed Management Act," this legislation defined the duty and authority of county and municipal governments to control noxious weeds, and required the adoption of management plans for undesirable plants for all such governing bodies. The Act authorizes local governing bodies of all counties and municipalities in Colorado to enter into cooperative agreements with federal and state agencies for the integrated management of noxious weeds within their respective territorial jurisdictions. In 1996 House Bill 96-1008 renamed and amended this Article as the "Colorado Noxious Weed Act," to establish and fund an office of state weed coordinator, and to institute the designation by rule of state and local noxious weed lists. Rules pertaining to the administration and enforcement of the Act, including the list of designated noxious weeds are published under the Code of Colorado Regulations (8 CCR 1206-2). The Act was further amended in 2003, codifying the classification of designated weeds (Table 2, Appendix 1). The commissioner of the Colorado Department of Agriculture is directed to develop and implement by rule state noxious weed management plans, including management objectives for noxious weed species classified as list A or list B species.

The Colorado state-wide plan (Lane 2001), which does not have the same regulations as the state statute and rules, emphasizes that an important aspect to weed control is site specific support for significant natural resources (Lane personal communication 2006).

Table 2. Three categories of noxious weeds designated by the Commissioner of the Colorado Department of Agriculture (Colorado Noxious Weed Act 2003).

A	Rare noxious weed species that are subject to eradication wherever detected statewide in order to protect neighboring lands and the state as a whole.
B	Noxious weed species with discrete statewide distributions that are subject to eradication, containment, or suppression in portions of the state designated by the commissioner in order to stop the continued spread of these species.
C	Widespread and well-established noxious weed species for which control is recommended but not required by the state, although local governing bodies may require management.

Wyoming Weed and Pest Control Act

The Wyoming Weed and Pest Control Act of 1973 established counties as weed and pest control districts in Wyoming. All federal, state, private and municipally owned lands are included in the weed and pest control district of the county in which they lie. District weed and pest control boards are appointed by the county commissioners, and have the authority to implement programs for the control of designated weeds. Designated noxious weeds are defined as "weeds, seeds or other plant parts that are considered detrimental, destructive, injurious or poisonous, either by virtue of their direct effect or as carriers of diseases or parasites that exist within this state, and are on the designated list." Rules pertaining to the Act are promulgated by the Wyoming Department of Agriculture, and published by the office of the Wyoming Secretary of State. Each district has a list of declared weeds that are plants which the board and the Wyoming weed and pest council have found to be detrimental to the general welfare of persons residing within a district. The statewide designated list of noxious weeds (Appendix 2) is designated by joint resolution of the board and the Wyoming weed and pest council.

County Noxious Weed Management Programs

The nine military installations covered in this document occupy portions of one county in Wyoming (Laramie) and five counties in Colorado (Arapahoe, El Paso, Fremont, Las Animas, and Pueblo). Each Colorado County has a Weed Management Coordinator. Appendix 3 includes contact information for the Weed Management Coordinators in each county, county weed lists, and website addresses, which provide links to the county level strategic plans (if available).

Methods/Prioritization Systems

Strategic weed plans are intended to help weed managers make the best use of available time and funding by determining which invasive species, and which specific infestations of those species should be the primary focus of weed control and restoration efforts. Invasive species control plans have been completed for six of the nine Front Range installations (Carpenter et al. 2004, North Wind 2005b-f). These plans use similar approaches based on a recognized prioritization system for addressing noxious weed issues, an exotic species ranking system developed by the National Park Service (Hiebert and Stubbendieck 1993). This strategic plan is intended to synthesize the available plans and additional natural resource information, with the primary goal of identifying the most critical weed infestations in need of control at the Front Range military installations.

Sources used to prioritize weed infestations include the individual facility/base control plans, Heibert and Stubbendieck (1993), and Invasive Species Impact Ranks (I ranks) of Morse et al. (2004). The Invasive Species Assessment Protocol (Morse et al. 2004, NatureServe 2006) has been used to develop I ranks and to produce detailed reports providing up-to-date information about ecological impacts, distribution, trends, and management issues for about 300 noxious weeds. This source includes Invasive Species Assessment reports on 26 of the 32 noxious weeds found on the Front Range military installations.

The primary factors considered for this strategy were: 1) the invasiveness of the plant, 2) the extent of the infestation, 3) the feasibility of successful control, and 4) the specific location of the invasive plant (i.e., proximity to areas with natural values).

1. To determine the invasiveness of a weed, or a weed's inherent potential for spreading, we used the NatureServe "trend in distribution" rank, as well as information provided in the individual control plans.

2. The extent of an infestation is reported in terms of the occupied acres that have been mapped at each installation (Fayette-Regier 2001, Anderson et al. 2003, North Wind 2005b-f, Carpenter et al. 2004), as well as information provided in the individual control plans, and/or from communication with one of the installation natural resource managers. Because acreage alone does not fully portray the problem posed by weed infestations, density of the plants in the infestations is reported when available.

3. To determine the feasibility or likelihood of successful control, or how hard the noxious weeds are to control, we used the NatureServe "management difficulty" rank, as well as information available from the control plans and/or resource managers.

4. Two methods were used to determine a weed's proximity to areas with important natural resources. The Biodiversity Tracking and Conservation System (BIOTICS) database (Colorado Natural Heritage Program 2006) was used to search for information on rare species and high quality plant communities found on each of the nine Front Range military installations. If noxious weeds were reported to occur within or immediately adjacent to occurrences of rare plants, animals, or high quality plant communities, this information is included in our analysis. Because the presence of noxious weeds near an occurrence may not have been reported in detail, we also conducted a Geographic Information System (GIS) analysis to determine which mapped locations of noxious weeds (Fayette-Regier 2001, Anderson et al. 2003, North Wind 2005a-f) fell within ¼ mile (about 400 meters) of the mapped locations of rare plants, animals and high quality plant communities. We consulted with several experts, and subjectively chose ¼ mile as an appropriate distance for the analysis to get some idea about which weeds might threaten the occurrences (Kettler personal communication 2006, Anderson personal communication 2006, Lane personal communication 2006, Fahnestock personal communication 2006). We recognize, however, that this distance may not be appropriate for all noxious weed species reported here. Some weeds may not threaten the natural resources from this distance, and others may pose a threat from much greater distances. For example, Saltcedar is not likely to be a threat to upland plant species, because of its habitat specificity in riparian areas. Knapweeds, on the other hand, are known to disperse widely, and may therefore pose threats to significant natural resources at distances much greater than ¼ mile.

The Colorado State Department of Agriculture quarter-quad weed mapping was also searched for weed locations on each of the nine military installations and surrounding areas to identify other potential or known noxious weed species. We did not, however, find any new weed locations through this source.

Finally, we also communicated with counties and states where the installations occur. We interviewed the county weed coordinators in El Paso, Pueblo, Arapahoe, Las Animas, and Fremont counties in Colorado, Laramie County in Wyoming, as well as the Colorado and Wyoming state weed coordinators to determine other potential issues including weed locations, and natural resource, agricultural, and economic values.

This strategy specifies site-specific weed control goals whenever possible (e.g., eradicate, suppress, contain, or monitor). However, for all of the top priority infestations (those with "very high" priority level), the primary goal for weed control should be protection of the significant plants, animals and plant associations that are threatened or potentially threatened by the infestation. Restoration of natural habitat condition and processes will greatly facilitate the control of weeds.

Results

A total of 34 noxious weeds have been documented on the nine Front Range military installations (Table 3). On a regional level, the highest priority infestations for control are: Spotted knapweed and Myrtle spurge at Fort Carson; Canada thistle, Dalmatian toadflax, and Leafy spurge at the federally threatened species locations at F. E. Warren AFB; Purple loosestrife (for monitoring) at Peterson AFB; African Rue and Russian knapweed at Pinon Canyon Maneuver Site; Saltcedar at significant community locations and Russian olive at Pueblo Chemical Depot; and Spotted knapweed, Leafy spurge, and Myrtle spurge at the U. S. Air Force Academy (Table 1). Myrtle Spurge, Purple loosestrife, and African Rue are also top priority for control (A list species) by the State of Colorado (Colorado Noxious Weed Act 2003).

Table 3. Thirty-four noxious weeds that have been documented on the nine Front Range military installations. The invasive species impact ranks were developed by NatureServe using "An Invasive Species Assessment Protocol: Evaluation Non-Native Plants for Their Impact on Biodiversity" (Morse et al., 2004). The full Colorado and Wyoming noxious weed lists are presented in Appendixes 1 and 2. Further details on the NatureServe invasive species impact ranks are in Appendix 4.

Common name	Scientific name	Invasive species impact rank	CO list	On WY list	Installation(s) where found
Russian knapweed	*Acroptilon repens (=Centaurea repens)*	High/Medium	B	yes	Pinon Canyon Maneuver Site (PCMS), U. S. Air Force Academy (USAFA)
Jointed goatgrass	*Aegilops cylindrica*	Medium/ Insignificant	C		Buckley, Fort Carson
Common burdock (=Lesser burdock)	*Arctium minus*	Medium/ Insignificant	C	yes	Fort Carson, PCMS, USAFA
Cheatgrass (=Downy brome)	*Bromus tectorum (=Anisantha tectorum)*	High	C		Buckley, Cheyenne, Fort Carson, Pueblo, Schriever, USAFA
Hoary cress	*Cardaria draba*	not ranked	B	yes	PCMS, Warren, USAFA
Plumeless thistle	*Carduus acanthoides*	Medium/Low	B	yes	Cheyenne
Musk thistle	*Carduus nutans*	High/Low	B	yes	Buckley, Cheyenne, Fort Carson, PCMS (needs to be confirmed - Rifici personal communication 2006), Schriever, Warren, USAFA
Diffuse knapweed	*Centaurea diffusa (=Acosta diffusa)*	High/Medium	B	yes	Buckley, Fort Carson, Schriever, USAFA

Common name	Scientific name	Invasive species impact rank	CO list	On WY list	Installation(s) where found
Spotted knapweed	*Centaurea maculosa (=Acosta maculosa, =Centaurea biebersteinii, =Centaurea stoebe* ssp. *micranthos)*	High/Medium	B	yes	Buckley, Fort Carson, Schriever, USAFA
Chicory	*Chichorium intybus*	Medium/ Insignificant	C		Pueblo, USAFA
Canada thistle	*Cirsium arvense (=Breea arvensis)*	High/Medium	B	yes	Buckley, Cheyenne, Fort Carson, Peterson, PCMS, Pueblo, Schriever, Warren, USAFA, (All bases)
Bull thistle	*Cirsium vulgare*	Medium/Low	B		Cheyenne, Peterson, PCMS (unconfirmed report), Pueblo (unconfirmed report), USAFA
Chinese clematis	*Clematis orientalis*	Medium/ Insignificant	B		Fort Carson
Poison hemlock	*Conium maculatum*	Medium/Low	C		PCMS, PCD, USAFA
Field bindweed	*Convolvulus arvensis*	Medium/Low	C	yes	Buckley, Cheyenne, Fort Carson, Peterson, PCMS, Pueblo, Schriever, Warren, USAFA (All bases)
Houndstongue	*Cynoglossum officinale*	Medium/Low	B	yes	Fort Carson, Warren
Fuller's teasel or Common teasel	*Dipsacus fullonum*	High/Low	B		Fort Carson, Pueblo (unconfirmed report), USAFA
Russian olive	*Elaeagnus angustifolia*	High	B		Buckley, Cheyenne, Fort Carson, Peterson, PCMS, Pueblo, Schriever, USAFA
Quackgrass	*Elytrigia repens (=Agropyron repens)*	not ranked	B	yes	PCD, USAFA
Redstem filaree or Pin clover	*Erodium cicutarium*	Medium/Low	B		Buckley, Fort Carson, PCMS, USAFA
Leafy spurge	*Euphorbia esula (=Tithymalus esula)*	High/Medium	B	yes	Buckley, Warren, USAFA
Myrtle spurge	*Euphorbia myrsinites*	Medium/Low	A		Fort Carson, USAFA
Black henbane	*Hyoscyamus niger*	Medium/ Insignificant	B		PCMS
Common St. Johnswort	*Hypericum perforatum*	High/Medium	C	yes	Fort Carson, Peterson, USAFA
Dalmatian toadflax, broad-leaved	*Linaria dalmatica*	not ranked	B	yes	Buckley, Fort Carson, Warren
Yellow toadflax	*Linaria vulgaris*	High/Low	B	yes	Buckley (unconfirmed report), Fort Carson, Peterson, USAFA
Purple loosetrife	*Lythrum salicaria*	High	A	yes	Peterson, Warren (evidently eradicated in 2005)
Scotch thistle	*Onopordum acanthium*	not ranked	B	yes	Buckley, USAFA
Wild proso millet	*Panicum miliaceum*	not ranked	C		USAFA
African rue	*Peganum harmala*	not ranked	A		PCMS
Bouncingbet	*Saponaria officinalis*	Low/ Insignificant	B		Fort Carson, Peterson, USAFA
Saltcedar	*Tamarix ramosissima*	High	B	yes	Buckley, Cheyenne, Fort Carson, Peterson, PCMS, Pueblo, USAFA
Puncturevine	*Tribulus terrestris*	not ranked	C		Fort Carson, Peterson, PCD, PCMS, Schriever
Common mullein	*Verbascum thapsus*	Medium	C		Buckley, Fort Carson, PCMS, Pueblo, Warren, USAFA

A total of 92 rare species and significant plant associations have also been documented on the nine Front Range military installations (Table 4). In all cases, the noxious weed infestations that have the greatest need for control are found within or in close proximity to occurrences of rare species and significant plant communities. Field surveys are needed to determine the level of threat the weeds currently pose to the significant natural areas. Where the weeds are actually invading the significant natural resources, habitat restoration will need to be integrated with weed control efforts to maintain the viability of important species. Weed control activities will need to be undertaken with the utmost caution because rare species and significant plant associations could easily be compromised or even destroyed with inappropriate management (Anderson personal communication 2006).

Table 4. Significant species and plant communities found at the nine Front Range military installations. For further information about the Conservation Status ranks see Appendix 4. For additional information about some of the rare species and ecological systems see Appendix 9.

Rare species	Scientific name	Conservation status rank	Federal status	State status	Installation(s)
VASCULAR PLANTS					
Plains ragweed (=Linear-leaf bursage)	*Ambrosia linearis*	G3 S3			Schriever
Fragrant indigobush (=Dwarf wild indigo)	*Amorpha nana*	G5 S2S3			PCMS, USAFA
Golden columbine	*Aquilegia chrysantha*	G4T1Q S1	BLM/ USFS		Cheyenne
Greene's Milkweed (= Dwarf milkweed)	*Asclepias uncialis* ssp. *uncialis*	G3G4T2T3 S2	BLM/ USFS		PCMS
Ebony spleenwort	*Asplenium platyneuron*	G5 S1			PCMS
Front Range milkvetch	*Astragalus sparsiflorus*	G3? S3?			Cheyenne
Barneby's feverfew	*Bolophyta tenraneuris (=Parthenium tetraneuris)*	G3 S3			Fort Carson
Mat grama	*Bouteloua simplex*	G5 S1			Warren
Crawe sedge	*Carex crawei*	G5 S1			Warren
Grassy slope sedge	*Carex oreocharis*	G3 S1			USAFA
Sandhill goosefoot	*Chenopodium cycloides*	G3G4 S1	USFS		PCD
Birdbill dayflower	*Commelina dianthifolia*	G5 S1?			Fort Carson
Colorado butterfly plant	*Gaura neomexicana* ssp. *coloradensis*	G3T2 S2	T		Warren
Richardson's alumroot	*Heuchera richardsonii*	G5 S1			USAFA
Strap-style gayfeather	*Lyatris ligulistylis*	G5? S1S2			USAFA
Round-leaf four-o'clock	*Mirabilis rotundifolia (=Oxybaphus rotundifolius)*	G2 S2			Fort Carson, PCMS
Star cloakfern (= Standley's cloak fern)	*Notholaena standleyi (=Cheilanthes standleyi)*	G4 S1			PCMS
Golden blazing star	*Nuttallia chrysantha=Mentzelia chrysantha*	G2 S2	BLM		Fort Carson
Arkansas Valley evening-primrose	*Oenothera harringtonii*	G2 S2	USFS		PCMS
Single-head goldenweed (=Rayless goldenweed)	*Oonopsis foliosa* var. *monocephala*	G2G3T2 S2			PCMS
Pueblo goldenweed	*Oonopsis puebloensis*	G2 S2			Fort Carson

Rare species	Scientific name	Conservation status rank	Federal status	State status	Installation(s)
Streambank groundsel	*Packera pseudaurea* var. *flavula*	G5T2T4 S1			Warren
Purple-stem cliffbrake (=Purple cliff-brake)	*Pellaea atropurpurea*	G5 S2S3			PCMS
Smooth cliffbrake	*Pellaea glabella* ssp. *simplex (= Pellaea suksdorfiana)*	G5T4? S2			PCMS
Wright's cliffbrake	*Pellaea wrightiana*	G5 S2			PCMS
Desert portulaca (=Dwarf purslane)	*Portulaca halimoides (=Portulaca parvula)*	G5 S1			PCMS
Southern Rocky Mountain cinquefoil	*Potentilla ambigens*	G3 S1S2			USAFA
Porter's feathergrass	*Ptilagrostis porteri*	G2 S2	BLM/ USFS		USAFA (Farish)
American currant (=Wild black currant)	*Ribes americana*	G5 S2			USAFA
Rosinweed	*Silphium integrifolium* var. *laeve*	G5T4? S1			Warren
Fendler's townsend daisy	*Townsendia fendleri*	G2 S1			Fort Carson
Plains ironweed	*Vernonia marginata*	G5? S1			USAFA
Prairie violet	*Viola pedatifida*	G5 S2			USAFA
New Mexico cliff fern	*Woodsia neomexicana*	G4? S2			PCMS, USAFA
BIRDS					
Grasshopper Sparrow	*Ammodramus savannarum*	G5 S4 Watchlist	USFS		Warren
Ferruginous Hawk	*Buteo regalis*	G4 S3B,S4N	BLM/ USFS	SC	Fort Carson, PCMS, PCD
McCown's Longspur	*Calcarius mccownii*	G4 S2	USFS		Warren
Chestnut-collared Longspur	*Calcarius ornatus*	G5 S1	USFS		Warren
Mountain Plover	*Charadrius montanus*	G2 S2B	BLM/ USFS	SC	Fort Carson, PCMS, PCD
Evening Grosbeak	*Coccothraustes vespertinus*	G5 S4			USAFA
Bald Eagle	*Haliaeetus leucocephalus*	G5 S1B,S3N	LT, PDL	ST	Fort Carson, PCMS
Lewis's Woodpecker	*Melanerpes lewis*	G4 S4	USFS		Fort Carson, PCMS
Ovenbird	*Seiurus aurocapilla*	G5 S2B			USAFA
Mexican Spotted Owl	*Strix occidentalis lucida*	G3T3 S1B,SUN	LT	ST	Fort Carson
FISH					
Arkansas darter	*Etheostoma cragini*	G3G4 S2	C	ST	Fort Carson
Southern redbelly dace	*Phoxinus erythrogaster*	G5 S1	USFS	SE	PCD, Fort Carson
AMPHIBIANS					
Canyon treefrog	*Hyla arenicolor*	G5 S2	BLM		PCMS
Plains leopard frog	*Rana blairi*	G5 S3	BLM/ USFS	SC	PCD, PCMS
Northern leopard frog	*Rana pipens*	G5 S3	USFS, BLM		Fort Carson, Warren

REPTILES					
Triploid Colorado checkered whiptail = Colorado checkered whiptail	*Aspidoscelis neotesselata*	G2G3 S2		SC	Fort Carson, PCD, PCMS
New Mexico thread snake = Texas blind snake	***Leptotyphlops dissectus***	G4G5 S1		SC	PCMS
Texas horned lizard	*Phrynosoma cornutum*	G4G5 S3	BLM	SC	PCMS
Massasauga	*Sistrurus catenatus*	G3G4 S2	BLM/ USFS	SC	PCD
INSECTS					
Sedge darner	*Aeshna juncea*	G5 S3			USAFA
Dusted skipper	*Atrytonopsis hianna*	G4G5 S2			Cheyenne
Moss's elfin (=Schryver's elfin)	*Callophrys mossii schryveri*	G4T3 S2S3			USAFA
Hops azure (=Hops feeding azure)	*Celastrina humulus*	G2G3 S2			USAFA
Cross line skipper	*Polites origenes*	G5 S3			Cheyenne, Fort Carson, (USAFA)
Simius roadside skipper	*Amblyscirtes simius*	G4S3			Schriever
Morrison's skipper	*Stinga morrisoni*	G4G5 S3S4			USAFA
Snow's skipper	*Paratrytone snowi*	G5 S3			USAFA
MAMMALS					
Black-tailed prairie dog	*Cynomys ludovicianus*	G3G4 S3-partial track	USFS	SC	Fort Carson, PCMS, PCD, (Peterson)
Silver-haired bat	*Lasionycteris noctivagans*	G5 S3B Watchlist			Warren
Dwarf shrew	*Sorex nanus*	G4 S4 Watchlist			Warren
Wyoming pocket gopher	*Thomomys clusius*	G2 S2	USFS, BLM		Warren
Swift fox	*Vulpes velox*	G3 S3	USFS	SC	PCMS
Preble's meadow jumping mouse	*Zapus hudsonius preblei*	G5T2 S1	LT, PDL	ST	Warren, USAFA
Merriam's shrew	*Sorex merriami*	G5 S3			USAFA

Ecological System	Common name	Scientific name	Conservation status rank	Installation(s)
PLANT COMMUNITIES				
Central Mixedgrass Prairie	Western Wheatgrass - Blue Grama Mixedgrass Prairie	*Pascopyrum smithii - Bouteloua gracilis* Herbaceous Vegetation	G5 S4 (partial track)	Cheyenne, Fort Carson, PCMS
Central Mixedgrass Prairie	Western Wheatgrass Mixedgrass Prairie	*Pascopyrum smithii* Herbaceous Vegetation	G3G5Q S2	PCMS
Inter-Mountain Basins Greasewood Flat	Inland Saltgrass Saline Prairie	*Distichlis spicata* Herbaceous Vegetation	G5 S3 (partial track)	PCD
Inter-Mountain Basins Greasewood Flat	Black Greasewood / Alkali Sacaton Sparse Vegetation	*Sarcobatus vermiculatus / Sporobolus airoides* Sparse Vegetation	G3? S2	PCD, PCMS
North American Arid West Emergent Marsh	Bulrush Wet Meadow	*Schoenoplectus pungens* Herbaceous Vegetation	G3G4 S3	PCD
Rocky Mountain Lower	Narrowleaf Cottonwood	*Populus angustifolia / Salix exigua*	G4 S4 (partial	USAFA

Ecological System	Common name	Scientific name	Conservation status rank	Installation(s)
Montane Riparian Woodland and Shrubland	Riparian Woodland	Woodland	track)	
Rocky Mountain Lower Montane Riparian Woodland and Shrubland	Sandbar Willow / Mesic Graminoids Shrubland	*Salix exigua* / Mesic Graminoids Shrubland	G5 S5 (partial track)	USAFA
Rocky Mountain Lower Montane-Foothill Shrubland	Western Snowberry Shrubland	*Symphoricarpos occidentalis* Shrubland	G4G5 S3 (partial track)	USAFA
Rocky Mountain Subalpine-Montane Riparian Shrubland	Thinleaf Alder / Red-osier Dogwood Shrubland	*Alnus incana / Cornus sericea* Shrubland	G3G4 S3	USAFA
Rocky Mountain Subalpine-Montane Riparian Shrubland	Thinleaf Alder / Mesic Graminoids Shrubland	*Alnus incana* / Mesic Graminoids Shrubland	G3 S3	USAFA
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	Gambel Oak / Long-stolon Sedge Shrubland	*Quercus gambelii / Carex inops* Shrubland	GU SU	Cheyenne, Fort Carson
Rocky Mountain Ponderosa Pine Woodland	Ponderosa Pine / Gambel Oak Woodland	*Pinus ponderosa / Quercus gambelii* Woodland	G5 S4 (partial track)	USAFA
Southern Rocky Mountain Juniper Woodland and Savanna	Foothills Pinyon-Juniper Woodland	*Juniperus monosperma- (Pinus edulis)/Cercocarpus montanus/ Schizachyrium scoparium* Woodland	GU SU	PCMS
Southern Rocky Mountain Juniper Woodland and Savanna	One-seed Juniper / Black Grama Woodland	*Juniperus monosperma / Bouteloua eriopoda* Woodland	GNR S2S3	PCMS
Southern Rocky Mountain Juniper Woodland and Savanna	One-seed Juniper / Blue Grama Woodland	*Juniperus monosperma / Bouteloua gracilis* Woodland	G5 S3S4	PCMS
Southern Rocky Mountain Juniper Woodland and Savanna	Scarp Woodlands	*Juniperus scopulorum/Cercocarpus montanus-Rhus trilobata W*oodland	GU SU	PCMS
Southern Rocky Mountain Montane-Subalpine Grassland	Parry's Oatgrass Herbaceous Vegetation	*Danthonia parryi* Herbaceous Vegetation	G3 S3	USAFA
Western Great Plains Closed Depression Wetland	Western Wheatgrass - Spikerush Mixedgrass Prairie (Playa)	*Pascopyrum smithii - Eleocharis* spp. Herbaceous Vegetation	G2 S2	Schriever
Western Great Plains Foothill and Piedmont Grassland	New Mexican Feathergrass Mixedgrass Prairie	*Hesperostipa neomexicana* Herbaceous Vegetation	G3 S3	Fort Carson
Western Great Plains Riparian Woodland and Shrubland	Plains Cottonwood / Western Wheatgrass-Vine Mesquite Woodland	*Populus deltoides / Pascopyrum smithii-Panicum obtusum* Woodland	G2 S2	PCD
Western Great Plains Riparian Woodland and Shrubland	Plains Cottonwood /Alkali Sacaton Woodland	*Populus deltoides / Sporobolus airoides* Woodland	G3 S2	PCD
Western Great Plains Sandhill Shrubland	Big Bluestem - Prairie Sandreed Mesic Tallgrass Prairie	*Andropogon gerardii - Calamovilfa longifolia* Herbaceous Vegetation	G2 S2	Peterson
Western Great Plains Shortgrass Prairie	Black Grama - Galleta Shortgrass Prairie	*Bouteloua eriopoda - Pleuraphis jamesii* Herbaceous Vegetation	G3 SU	PCMS

Ecological System	Common name	Scientific name	Conservation status rank	Installation(s)
Western Great Plains Shortgrass Prairie	Blue Grama - Galleta Shortgrass Prairie	*Bouteloua gracilis - Pleuraphis jamesii* Herbaceous Vegetation	G2G4 S3	PCMS

Results/Summary of each installation (Presented in alphabetical order)

Buckley Air Force Base

Buckley Air Force Base is located in Arapahoe County, Colorado, east of the Denver metropolitan area. Elevations on the 3,283 acre base range from 5475 to 5,700 feet. Terrain is generally flat to gently sloping. The climate at Buckley AFB is warm and semiarid; with average annual precipitation at the nearby Denver Weather Service Field Office (WSFO) Airport station of 15.48 inches, and average temperatures ranging from 17 ºF in January to 88 ºF in July. The majority of the northern half of the installation is developed. Undeveloped areas west of the runway appear to have been heavily disturbed in the past and include little native vegetation. Remaining natural vegetation communities on the base are members of the Western Great Plains Shortgrass Prairie and Riparian Woodland and Shrubland ecological systems.

Fourteen noxious weed species have been documented at Buckley AFB (Fayette et al. 2000a, North Wind 2005b, Table 5). Spotted knapweed (*Centaurea maculosa*) may occur here as well, but the identification of the species has not been confirmed. Confirming the identification of this weed, and eradication if it is Spotted knapweed, is a high priority for weed control at Buckley. The other high priority species for this installation are Diffuse knapweed, Canada thistle, Russian olive, Leafy spurge, and Dalmatian toadflax (Table 5). Kochia (*Kochia scoparia*) and Russian thistle (*Salsola kali*) were mapped at Buckley (North Wind 2005b), but they are not considered to be noxious weeds at a federal, state, or county level, and are therefore not considered in this report. Twenty other non-native plant species were also documented (Appendix 5). Fayette et al. (2000a) reported that non-native plant species are prevalent on the installation and represent a high priority management issue. The invasive plant species control plan for the base (North Wind 2005b) list eleven species as having "a strong presence" on the installation.

Table 5. Noxious weeds known from Buckley Air Force Base (North Wind 2005b). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plan (North Wind 2005b). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank ---------- Feasibility of control[3]	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Jointed goatgrass	*Aegilops cylindrica*	High/Medium	not mapped	High/Low	Low. No intersection with important natural resources.
Cheatgrass	*Bromus tectorum*	Medium	85	High/Medium	Medium. No intersection with important natural resources.

Noxious weed species known from installation[1]	**Scientific name**	**Invasiveness of species[2]**	**Total area mapped at installation (acres)**	**NatureServe management difficulty rank ---------- Feasibility of control[3]**	**Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.**
Musk thistle	*Carduus nutans*	High/Medium	286	High/Medium	Medium. No intersection with important natural resources.
Diffuse knapweed	*Centaurea diffusa*	High/Medium	<1	High/Medium	High. Eradicate while occurrence is small. No intersection with important natural resources.
Spotted knapweed*	*Centaurea maculosa**	High/Medium	one isolated population	High/Low ---------- Medium/ Hard	High. Confirm identification and eradicate. Elimination is required in all Colorado counties except La Plata. Use only management techniques approved by commissioner. Biocontrol for this species is not permitted. Monitor for 15 years (Colorado Noxious Weed Act 2003). No intersection with important natural resources.
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	15	High/Medium ---------- Hard	High. Occurs in natural areas, not just along roads or developed areas. Contain or eradicate as possible. No intersection with important natural resources, though it is in a natural drainage. Found across base, away from roads, and in natural drainage (as seen from map in North Wind report)
Field bindweed	*Convolvulus arvensis*	High/Medium	22	High/Medium ---------- Hardest	Medium. Very difficult to control, no intersection with natural resource values.
Russian olive	*Elaeagnus angustifolia*	High/Medium	<1	High ---------- Hard	High. Control before infestation grows. No intersection with important natural resources.
Redstem filaree	*Erodium cicutarium*	Medium/Low	not mapped	Medium/Low	Low.
Leafy spurge	*Euphorbia esula*	High/Low	31	High ---------- Hard	High. Arapahoe County is working on containing and suppressing this, high priority for County. No intersection with important natural resources.
Dalmatian toadflax	*Linaria dalmatica*	not ranked	34	not ranked ---------- Hard	High. Arapahoe County treats this as an A list species, high priority for County. No intersection with important natural resources.
Yellow toadflax*	*Linaria vulgaris**	Medium/Low	not mapped	High/Medium	Medium. Not a major threat because of the dry habitat found at Buckley; this species doesn't invade too much in this area. Try to treat quickly anyway before the species spreads any further. This species is slow growing here, which will afford some time to treat infestations. Arapahoe County treats this as an A list species, high priority for County.
Scotch thistle	*Onopordum acanthium*	not ranked	not mapped	not ranked	Low. No intersection with important natural resources.
Saltcedar	*Tamarix ramosissima*	High/Low	not mapped	High/Medium	Medium. No intersection with important natural resources. Arapahoe County treats this as an A list species, high priority for County.
Common mullein	*Verbascum thapsus*	Medium	not mapped	Low	Low. No intersection with important natural resources.

1 North Wind 2005b *identification uncertain
2 following NatureServe Trend in Distribution Rank
3 as detailed in plan and through personal communication

There are no rare species or plant communities reported from Buckley AFB, and little potential for their occurrence in this urban setting. Although recognizable, the quality, size and landscape context of the plant communities are not significant according to Colorado Natural Heritage Program methodology.

Cheyenne Mountain Air Force Station

Cheyenne Mountain Air Force Station is located in El Paso County, Colorado, on the southeast edge of the city of Colorado Springs. The installation itself is largely below ground, but surface elevations range from about 6,450 feet at the eastern edge to around 9,020 on the slopes below the summit of Cheyenne Mountain. Most of the area is steep, rocky mountainside. The climate at the installation should be similar to that of the northern end of Fort Carson (see below), but with slightly more precipitation and lower average temperatures, due to the higher elevation. The eastern edge of the station includes developed areas (roads, parking areas, support structures, etc.), but the majority of the surface area is dominated by native communities belonging to the Rocky Mountain Gambel Oak – Mixed Mountain Shrubland, Ponderosa Pine Woodland, or Mixed Conifer Forest and Woodland ecological systems.

The Cheyenne Mountain Air Force Station is within the Cheyenne Mountain Potential Conservation Area (PCA) delineated by the Colorado Natural Heritage Program (CNHP 2006). The PCA extends from the edge of the rolling prairie grasslands near Highway 115 to nearly the top of Cheyenne Mountain and includes most of the Limekiln Valley, portions of the Cheyenne Mountain Air Force Station, and some private and federal lands to the north and west. This area represents an ecotone between the prairie grasslands of the Great Plains and the lower montane foothill forests of the Front Range and supports one of the best remaining examples of the Front Range foothills mesic oak-shrub ecosystems. On higher elevation areas, including the Air Force Station, forests of ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) dominate steep rocky slopes. A mosaic of mixed woodlands and shrublands of Douglas fir, ponderosa pine, one-seeded juniper (*Juniperus monosperma*), pinyon pine (*Pinus edulis*), Gambel's oak (*Quercus gambelii*), mountain mahogany (*Cercocarpus montanus*), and skunkbush sumac (*Rhus trilobata*) forms an interface between the prairie and woodland ecosystems.

Eight noxious weed species have been documented at Cheyenne Mountain Air Force Station (North Wind 2005c, Table 6). All of the weed infestations appear to be fairly small at this time except for Musk thistle (4.4 acres mapped) and Canada thistle (3.4 acres, North Wind 2005c). Musk thistle and Canada thistle are among the top species targeted for control by El Paso County (El Paso County 2005). Field surveys are needed to determine whether or not these species threaten occurrences of rare species or significant plant communities. Plumeless thistle, Russian olive, and Saltcedar appear to be the highest priority for management at this installation (Table 6). The Colorado Noxious Weed Act (2003) requires that all infestations of Plumeless thistle be eradicated. Russian olive and Saltcedar are known from very small infestations at the Cheyenne Mountain AFS. They appear to be in close proximity to an occurrence of the globally imperiled Golden columbine, and occupy similar riparian habitats. The infestations of Russian olive and Saltcedar should be relatively easy to control (North Wind 2005c). Two additional invasive plants are mentioned in the Control Plan (North Wind 2005c), Russian thistle (*Salsola kali*) and Kochia (*Kochia scoparia*); these species are

not on the Federal, State, or County weed lists and are therefore not considered in this strategy. Other non-native plants documented at Cheyenne Mountain AFS are listed in Appendix 5.

Table 6. Noxious weeds known from the Cheyenne Mountain Air Force Station (North Wind 2005c). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plan (North Wind 2005c). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	**Scientific name**	**Invasiveness of species[2]**	**Total area mapped at installation (acres)**	**NatureServe management difficulty rank ---------- Feasibility of control[3]**	**Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.**
Cheatgrass	*Bromus tectorum*	Medium	<1	High/Medium	Medium. Potentially invading rare plant and significant community locations. Small area mapped so may be easier to control now.
Plumeless thistle	*Carduus acanthoides*	High/Medium	very small, < 0.1	not ranked	High priority for elimination. State requires eradication. Small infestation should be relatively easy to control (North Wind 2005c). Potential threat to significant plant communities. No biocontrol. Only control methods approved by commissioner. Monitor for at least 10 years (Colorado Noxious Weed Act 2003).
Musk thistle	*Carduus nutans*	High/Medium	4.4	High/Medium	Medium. Potentially intersects all occurrences. On El Paso County Weed List.
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	3.4	High/Medium ---------- Hard	Medium. Potentially intersects all occurrences. On El Paso County Weed List.
Bull thistle	*Cirsium vulgare*	Medium/Low	very small, < 0.1	Medium/Low	Medium. Not highly invasive. Small infestation should be relatively easy to control (North Wind 2005c). Potential intersect with Golden columbine occurrence
Field bindweed	*Convolvulus arvensis*	High/Medium	<1	High/Medium ---------- Hardest	Medium. Potentially intersects all occurrences.
Russian olive	*Elaeagnus angustifolia*	High/Medium	very small, < 0.1	High ---------- Hard	High priority for elimination. Small infestation should be relatively easy to control (North Wind 2005c), potential intersect with Golden columbine occurrence
Saltcedar	*Tamarix ramosissima*	High/Low	very small, < 0.1	High/Medium	High priority for elimination. Small infestation should be relatively easy to control (North Wind 2005c), potential intersect with Golden columbine occurrence

1 North Wind 2005c
2 following NatureServe Trend in Distribution Rank
3 as detailed in plan and through personal communication

Six occurrences of rare species or significant plant communities have been documented at the Cheyenne Mountain Air Force Station (Table 7). Specific threats to these occurrences resulting from noxious weed infestations are not known. GIS analyses indicated that weeds may threaten occurrences since they are found within ¼-1 mile (about 0.4-1.6 kilometers) of mapped locations of weeds (Table 7).

Table 7. Rare species and significant plant communities known from the Cheyenne Mountain Air Force Station (Colorado Natural Heritage Program 2006). Specific threats to these occurrences resulting from noxious weed infestations are not known. Analyses indicated that weeds may threaten occurrences because of their close proximity. Further details on the Conservation status ranks are in Appendix 4.

PLANTS					
Common name	**Scientific name**	**Conservation status rank**	**Federal Status**	**State status**	**Last documented**
Golden columbine	***Aquilegia chrysantha***	**G4T1Q S1**	**BLM/USFS**		**1995**
Documented threats from noxious weeds[1] None reported		Potential threats from noxious weeds[2] Cheatgrass, Bull thistle, Musk thistle, Canada thistle, Field bindweed, Russian olive, Saltcedar are documented within 1/4 mile of occurrence.			
Front Range milkvetch	***Astragalus sparsiflorus***	**G3? S3?**			**1995**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Cheatgrass, Musk thistle, Canada thistle, and Field bindweed appear to be within 1 mile of occurrence.			
INSECTS					
Common name	**Scientific name**	**Conservation status rank**	**Federal Status**	**State status**	**Last documented**
Dusted skipper	***Atrytonopsis hianna***	**G4G5 S2**			**1977**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Cheatgrass, Musk thistle, Canada thistle, and Field bindweed appear to be within 1 mile of occurrence.			
PLANT COMMUNITIES					
Common name	**Scientific name**	**Conservation status rank**	**Federal Status**	**State status**	**Last documented**
Western Wheatgrass - Blue Grama Mixedgrass Prairie	***Pascopyrum smithii - Bouteloua gracilis*** Herbaceous Vegetation	**G5 S4**			**2000**
Documented threats from noxious weeds Occurrence is mostly weed free but does have some areas of Common mullien. Areas with Common mullein may not be on the installation.		Potential threats from noxious weeds Cheatgrass, Musk thistle, Canada thistle, Plumeless thistle, Scotch thistle, and Field bindweed are mapped within 1/4 mile of occurrence.			
Gambel Oak / Long-stolon Sedge Shrubland	***Quercus gambelii/Carex inops*** Shrubland	**GU SU**			**2000**
Documented threats from noxious weeds Occurrence is mostly weed free but does have some areas of Common mullien. Areas with Common mullein may not be on the installation.		Potential threats from noxious weeds Cheatgrass, Musk thistle, Canada thistle, Plumeless thistle, Scotch thistle, and Field bindweed are mapped within 1/4 mile of occurrence.			

1 Weeds documented at occurrence

2 Weeds documented within 1/4 miles of occurrence, or within 1 mile for elements with imprecise location.

Fort Carson Military Reservation

Fort Carson is located on the southern edge of the city of Colorado Springs, Colorado, at the foot of the Rocky Mountain Front Range. The 137,404 acre installation occupies portions of El Paso, Pueblo, and Fremont Counties. Elevations on the installation range from about 5,200 to 6,900 feet. At the eastern edge of the reservation terrain is dominated by low plains consisting of flat to gently rolling alluvial deposits in the Fountain Creek drainage. Much of the remainder of the installation is characterized by moderately hilly and strongly dissected terrain with scattered rocky escarpments (Department of the Army 1980). Surface drainage on the reservation consists entirely of intermittent streams that flow only during periods of snowmelt runoff or following intense rainfall events.

Climate is somewhat variable over the approximate 25 mile north-south extent of the installation, with higher temperatures and lower precipitation expected in the southern portions. Average annual precipitation at the Fort Carson weather station near Colorado Springs is about 18 inches. Average monthly temperatures range from 19-22 ºF in winter months to 81-86 ºF in summer.

With the exception of the cantonment area at the north end of the reservation, the installation is largely dominated by native vegetation in a mosaic of woodland, shrubland, grassland, and riparian plant associations that are typical of the ecotone between the plains and foothills. Woodlands associations belong to the Southern Rocky Mountain Pinyon-Juniper ecological system. Shrubland associations are members of the Rocky Mountain Gambel Oak – Mixed Montane Shrubland, Rocky Mountain Lower Montane-Foothill Shrubland, Intermountain Basin Mixed Salt Desert Scrub, and Intermountain Basins Greasewood Flat ecological systems. Grassland associations represent both the Western Great Plains Foothill and Piedmont Grassland and Western Great Plains Shortgrass Prairie systems. Riparian areas include plant associations of both Western Great Plains Riparian Woodland and Shrubland, and the North American Arid West Emergent Marsh ecological systems.

Twenty noxious weeds have been documented at the Fort Carson Military Reservation (Rifici personal communication 2006, Colorado Natural Heritage Program 2006, Table 8). Mapped locations of weeds were only available for the cantonment area, covering a small portion of the installation (Rifici personal communication 2006). We therefore relied more heavily on the Colorado Natural Heritage Program element occurrence records (Table 9) to determine which weeds were priorities for control. On a regional level the highest priority weeds for control at Fort Carson are Myrtle spurge and Spotted knapweed. Other non-native plants that have been documented at Fort Carson are listed in Appendix 5.

Table 8. Noxious weeds known from the Fort Carson Military Reservation (Rifici personal communication 2006, Colorado Natural Heritage Program 2006). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plan (DECAM 1999). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Jointed goatgrass	*Aegilops cylindrica*	High/Medium	not mapped	High/Low	Low. Found at a few erosion control dams from contaminated mulch hay. Seed viable for 5 years. Hand pulling only method of control because it occurs with seeded grass species*. On the Pueblo County weed list.
Common burdock	*Arctium minus*	High/Low	not mapped	Medium/ Insignificant	Low. Intersection with important natural resources is unknown. Not on El Paso or Pueblo County Weed Lists.
Cheatgrass	*Bromus tectorum (=Anisantha tectorum)*	Medium	not mapped	High/Medium	High at rare species and significant community occurrences. Medium elsewhere.
Musk thistle	*Carduus nutans*	High/Medium	0.8	High/Medium	High at rare species and significant community occurrences. Medium elsewhere. Many occurrences infested with biological control insects. On El Paso, Pueblo and Fremont County Weed Lists.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Diffuse knapweed	*Centaurea diffusa (=Acosta diffusa)*	High/Medium	0.6	High/Medium	High. No intersection with important natural resources. High on draft management plan. On El Paso, Fremont, and Pueblo County Weed Lists.
Spotted knapweed	*Centaurea maculosa*	High/Medium	12.8	High/Low	Very High at rare species and significant community occurrences. Medium elsewhere. High on draft management plan. On El Paso, Fremont, and Pueblo County Weed Lists.
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	11.4	High/Medium	High at rare species and significant community occurrences. Medium elsewhere. High on draft management plan. On El Paso, Fremont, and Pueblo County Weed Lists.
Chinese clematis	*Clematis orientalis*	High/Low	Possibly eradicated	Unknown	High if found. El Paso County survey indicated only one plant close to Fort Carson on the west side of the installation; that plant was treated in 2006*.
Field bindweed	*Convolvulus arvensis*	High/Medium	not mapped	High/Medium	High at rare species and significant community occurrences. Medium elsewhere. On Fremont and Pueblo County Weed Lists.
Houndstongue	*Cynoglossum officinale*	Medium/Low	one plant documented in past, probably eradicated.	Medium/Low	Low if found. On the Fremont County Weed list.
Common teasel	*Dipsacus fullonum*	Medium	not mapped	High/Low	Medium. In wet areas mostly contained in the Cantonment area. Will be treated with other species such as Canada thistle, knapweeds, Yellow toadflax, tamarisk, Russian olive*.
Russian olive	*Elaeagnus angustifolia*	High/Medium	not mapped	High	High where escaped into natural areas. Low where planted for ornamental purposes.
Redstem filaree	*Erodium cicutarium*	Medium/Low	not mapped	Medium/Low	Low. Intersection with important natural resources is unknown.
Myrtle spurge	*Euphorbia myrsinites*	High/Low	small area	High/Low	Very high. Eliminate immediately where found. Not believed to be common on the installation. A survey of the Cantonment area is planned for 2008 as per pending agreement with Colorado Department of Agriculture, June 2007*.
Common St. Johnswort	*Hypericum perforatum*	High/Medium	not mapped	High	Low. Roadside mowing takes care of the only know population of this species*.
Yellow toadflax	*Linaria vulgaris*	Medium/Low	small scattered patches	High/Medium	High. Eliminate patches while they are small. On El Paso, Pueblo and Fremont county weed lists.
Bouncingbet	*Saponaria officinalis*	Unknown	not mapped	Unknown	Medium in areas with high quality natural resources in riparian zones*.
Salt cedar	*Tamarix ramosissima*	High/Low	0.8	High/Medium	Medium. May intersect some natural resources, but they are not found in riparian areas. High in draft management plan. On Pueblo County Weed List. Some populations slated for insect biological control by 2008*.
Puncturevine	*Tribulus terrestris*	not ranked	not mapped	not ranked	Low. Intersection with important natural resources is unknown.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Common mullein	*Verbascum thapsus*	Medium	not mapped	Low	Low.

1 personal communication Rifici 2006, Colorado Natural Heritage Program 2006. *Rifici personal communication 2006
2 following NatureServe Trend in Distribution Rank.

A total of 45 occurrences of 20 significant plants, animals and plant associations have been documented at Fort Carson Military Reservation (Table 9, Colorado Natural Heritage Program 2006). Spotted knapweed was specifically reported with one occurrence of the rare Birdbill dayflower. Cheatgrass and Field bindweed were reported with occurrences of the globally imperiled Round leaf four o'clock, and the globally vulnerable Barneby's feverfew. Cheatgrass was also reported as occurring with the globally imperiled Golden blazing star. Two of the significant plant community records report Common mullein as a possible threat, but it is not known if these infestations are within the military reservation boundary (these occurrences are found on Fort Carson and continue on adjacent private land). GIS analyses indicated that weeds may threaten other occurrences since they are found within ¼-1 mile (about 0.4-1.6 kilometers) of mapped locations of weeds (Table 9).

Table 9. Rare species and significant plant communities known from the Fort Carson Military Reservation (Colorado Natural Heritage Program 2006). Specific threats to these occurrences resulting from noxious weed infestations are not known. Analyses indicated that weeds may threaten occurrences because of their close proximity. Further details on the Conservation status ranks are in Appendix 4.

PLANTS					
Common name	**Scientific name**	**Conservation status rank**	**Federal Status**	**State status**	**Last documented**
Barneby's feverfew	***Bolophyta tenraneuris (=Parthenium tetraneuris)***	**G3 S3**			**2005**
Documented threats from noxious weeds[1] One occurrence record reports Field bindweed and Cheatgrass.		Potential threats from noxious weeds[2] Unknown			
Birdbill dayflower	***Commelina dianthifolia***	**G5 S1?**			**2004**
Documented threats from noxious weeds One occurrence record reports Spotted knapweed.		Potential threats from noxious weeds Unknown			
Golden blazing star	***Nuttallia chrysantha (=Mentzelia chrysantha)***	**G2 S2**	**BLM**		**2004**
Documented threats from noxious weeds One occurrence record reports cheatgrass.		Potential threats from noxious weeds Unknown			
Pueblo goldenweed	***Oonopsis puebloensis***	**G2 S2**			**2007**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Unknown			
Round-leaf four-o'clock	***Oxybaphus rotundifolius (=Mirabilis rotundifolia)***	**G2 S2**			**2007**
Documented threats from noxious weeds One occurrence record reports Field bindweed and Cheatgrass.		Potential threats from noxious weeds Unknown			
Fendler's townsend daisy	***Townsendia fendleri***	**G2 S1**			**2006**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Unknown			

BIRDS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Ferruginous Hawk	***Buteo regalis***	**G4 S3B,S4N**	**BLM/USFS**	**SC**	**1992**
Documented threats from noxious weeds Field bindweed is infesting prairie dog colonies and therefore poses a potential threat to Ferruginous hawks in this area. Bindweed mites will be introduced to these areas 2007 and 2008 if necessary*.		Potential threats from noxious weeds Unknown			
Mountain Plover	***Charadrius montanus***	**G2 S2B**	**BLM/USFS**	**SC**	**2003**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Bald Eagle	***Haliaeetus leucocephalus***	**G5 S1B,S3N**	**LT, PDL**	**ST**	**2004**
Documented threats from noxious weeds Field bindweed is infesting prairie dog colonies and therefore poses a potential threat to Bald Eagles in this area. Bindweed mites will be introduced to these areas 2007 and 2008 if necessary*.		Potential threats from noxious weeds Musk thistle, Canada thistle, Spotted knapweed, and Saltcedar are mapped within 1/4 mile of occurrence. Saltcedar does not likely pose a threat.			
Lewis's Woodpecker	***Melanerpes lewis***	**G4 S4**	**USFS**		**2000**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Mexican Spotted Owl	***Strix occidentalis lucida***	**G3T3 S1B,SUN**	**LT**	**ST**	**1873**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

AMPHIBIANS & REPTILES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Colorado checkered whiptail (=Triploid Colorado checkered whiptail)	***Aspidoscelis neotesselata***	**G2G3 S2**		**SC**	**1994**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Northern leopard frog	*Rana pipens*	**G5 S3**	**USFS, BLM**		**Unknown**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

FISH

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Arkansas darter	***Etheostoma cragini***	**G3G4 S2**	**C**	**ST**	**1985**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Southern redbelly dace	*Phoxinus erythrogaster*	**G5 S1**	**USFS**	**SE**	**Unknown**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

INSECTS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Cross line skipper	***Polites origenes***	**G5 S3**			**1973**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

MAMMALS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Black-tailed prairie dogs	***Cynomys ludovicianus***	**G3G4 S3 partial track**	**USFS**	**SC**	**2005**
Documented threats from noxious weeds Field bindweed is a significant threat. Bindweed mites will be introduced to these areas 2007 and 2008 if necessary*.		Potential threats from noxious weeds Musk thistle, Canada thistle, Spotted knapweed, and Saltcedar are mapped within 1/4 mile of occurrence. Saltcedar is not likely a threat.			

PLANT COMMUNITIES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
New Mexican Feathergrass Mixedgrass Prairie	***Hesperostipa neomexicana*** herbaceous vegetation	**G3 S3**			**2000**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Western Wheatgrass - Blue Grama Mixedgrass Prairie	***Pascopyrum smithii-Bouteloua gracilis*** herbaceous vegetation	**G5 S4 partial track**			**2000**
Documented threats from noxious weeds Occurrence record reports Common mullein.		Potential threats from noxious weeds Musk thistle and Canada thistle are mapped within 1/4 mile of occurrence.			
Gambel Oak / Long-stolon Sedge Shrubland	***Quercus gambelii/Carex inops***	**GU SU**			**2000**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Musk thistle, Canada thistle, and Spotted knapweed are mapped within 1/4 mile of occurrence.			

1 Weeds documented at occurrence.
2 Weeds documented within 1/4 miles of occurrence, or within 1 mile for elements with imprecise location.

Francis E. Warren Air Force Base

Francis E. Warren Air Force Base is located in Laramie County in southeastern Wyoming. The 5,866 acre base lies adjacent to the western edge of the city of Cheyenne. Elevations range from about 6,100 feet along Crow Creek in the middle of the base to 6,350 feet at the north end of the installation. The installation occupies generally flat terrain that was historically comprised primarily of mixed-grass prairie and riparian bottomlands. The climate of southeastern Wyoming is generally dry and windy. Average annual precipitation at the Cheyenne Airport is 15.17 inches. Average minimum temperatures are 15.6-17.8 ºF in winter months (Dec-Feb) and average maximum summer (Jun-Aug) temperatures are 74.6-82.6 ºF. Monthly average wind speeds are in the 10-15 mph range. Although much of the installation has been disturbed at some point, significant amounts of native vegetation remain, especially in the northern part of the base. Current vegetation includes mixed-grass prairie, grasslands dominated by planted crested wheatgrass (*Agropyron cristatum*), riparian bottomlands with willow thickets, dry and wet meadows, and scattered cottonwood trees (Barlow and Knight 1999).

Eight noxious weed species have been documented at F. E. Warren AFB (North Wind 2005d, Table 10). The highest priority infestations for control are infestations of Canada thistle, Dalmatian toadflax, and leafy spurge where they are compromising the federally threatened species occurrences. While it may not be possible to eliminate these weeds at these locations, it is a very high priority to suppress these infestations to assure the long-term survival of the important natural

resources. Vipers bugloss *(Echium vulgare)* is on the Laramie County Declared List of Weeds and Pests. Although this species has not been documented on the Warren AFB, an infestation is known from just 2 miles outside the AFB boundary (Franklin personal communication 2006). This species would be a very high priority for control if found at Warren. A list of other non-native plants that have been documented at Warren is in Appendix 5.

Table 10. Noxious weeds known from F. E. Warren AFB (North Wind 2005d). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plan (North Wind 2005d). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	**Scientific name**	**Invasiveness of species[2]**	**Total area mapped at installation (acres)**	**NatureServe management difficulty rank ---------- Feasibility of control[3]**	**Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.**
Hoary cress	*Cardaria draba*	not ranked	27 acres, but few individuals	not ranked ---------- Hard	Medium. Small infestations should be relatively easy to control. Infestations are in close proximity to occurrences of Preble's meadow jumping mouse, Colorado butterfly plant, Rosinweed, and Streambank groundsel.
Musk thistle	*Carduus nutans*	High/Medium	5.2	High/Medium	High. Small infestation near Colorado butterfly plant.
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	615 acres, widespread across base, especially lowlands within stream drainages	High/Medium ---------- Hard	Very high at rare species occurrences (see specific examples of where in Heidel and Laursen 2002). Low elsewhere.
Field bindweed	*Convolvulus arvensis*	High/Medium	59	High/Medium ---------- Hard	Medium. Large infestations in close proximity to ten significant species occurrences including Preble's meadow jumping mouse and Colorado butterfly plant.
Houndstongue	*Cynoglossum officinale*	Medium/Low	46	Medium/Low ---------- Hard	High. Infestations are in close proximity to occurrences of rare species, including Preble's meadow jumping mouse and Colorado butterfly plant. High (Heidel and Laursen 2002)
Leafy spurge	*Euphorbia esula*	High/Low	22 to 96.8*	High ---------- Hard	Very high at rare species occurrences (see specific examples of where in Heidel and Laursen 2002). Low elsewhere.
Dalmatian toadflax	*Linaria dalmatica*	not ranked	1,973 acres, widespread across base, especially lowlands within stream drainages	not ranked ---------- Hard	Very high at rare species occurrences. Low elsewhere. High (Heidel and Laursen 2002)

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank ---------- Feasibility of control[3]	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Purple loosestrife	*Lythrum salicaria*	High	small colony was manually removed in 1998*	High	High for monitoring and eradication if found again. No intersection with natural resource values known. High (Heidel and Laursen 2002).

1 North Wind 2005d, CEMML 1995. *Heidel and Laursen 2002.
2 following NatureServe Trend in Distribution Rank.
3 as detailed in plan and through personal communication.

A total 13 significant plants and animals have been documented at F. E. Warren AFB (Table 11, Wyoming Natural Diversity Database 2006) including two federally threatened species, Colorado butterfly plant and Preble's meadow jumping mouse. Many of the rare species occurrences are known to have serious weed infestation problems, and GIS analyses indicated that weeds may threaten all of the other rare species since they are found within ¼-1 mile (about 0.4-1.6 kilometers) of mapped locations of weeds (Table 11).

Table 11. Rare species known from F. E. Warren AFB (Wyoming Natural Diversity Database 2006). Analyses indicated that weeds may threaten all of the rare species because of their close proximity. Further details on the Conservation status ranks are in Appendix 4.

PLANTS					
Common name	**Scientific name**	**Conservation status rank**	**Federal Status**	**State status**	**Last documented**
Mat grama	***Bouteloua simplex***	**G5 S1**	**none**		**2002**
Documented threats from noxious weeds[1] None reported		Potential threats from noxious weeds[2] Dalmatian toadflax and Canada thistle have been documented within 1/4 mile of this species.			
Crawe sedge	***Carex crawei***	**G5 S1**	**none**		**1997**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Dalmatian toadflax, Field bindweed, Canada thistle, and Houndstongue have been documented within 1/4 mile of this species.			
Colorado butterfly plant	***Gaura neomexicana*** ssp. ***coloradensis***	**G3T2 S2**	**T**		**2004**
Documented threats from noxious weeds Heidel and Laursen (2002) indicate that Canada thistle and Leafy spurge have the most overlap, covering 30.6% and 20.3% of 5.2 acres of butterfly plant habitat. Noxious weeds cover 67% of Colo butterfly plant habitat (Fertig and Arnett 2001).		Potential threats from noxious weeds Field bindweed, Canada thistle, Dalmatian toadflax, Houndstongue, Hoary cress, Leafy spurge, and Musk thistle have been documented within 1/4 mile of this species.			
Streambank groundsel	***Packera pseudaurea*** var. ***flavula***	**G5T2T4 S1**	**none**		**1983**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Canada thistle appears to be within 1/4 mile of the occurrence.			
Rosinweed	***Silphium integrifolium*** var. ***laeve***	**G5T4? S1**	**none**		**1996**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Canada thistle, Houndstongue, Field bindweed, Dalmatian toadflax, Hoary cress, and Leafy spurge have been documented within 1/4 mile of this species.			

BIRDS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Grasshopper Sparrow	***Ammodramus savannarum***	**G5 S4 Watchlist**	**USFS**		**2001**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Dalmatian toadflax and Canada thistle have been documented within 1/4 mile of this species.			
McCown's Longspur	***Calcarius mccownii***	**G4 S2**	**USFS**		**2001**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Dalmatian toadflax and Canada thistle have been documented within 1/4 mile of this species.			
Chestnut-collared Longspur	***Calcarius ornatus***	**G5 S1**	**USFS**		**2001**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Dalmatian toadflax and Canada thistle have been documented within 1/4 mile of this species.			

AMPHIBIANS & REPTILES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Northern leopard frog	***Rana pipens***	**G5 S3**	**USFS, BLM**		**2004**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Canada thistle, Leafy spurge, Houndstongue, Field bindweed, and Dalmatian toadflax have been documented within 1/4 mile of this species.			

MAMMALS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Silver-haired bat	***Lasionycteris noctivagans***	**G5 S3B Watchlist**	**none**		**unknown**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Dalmatian toadflax, Canda thistle, and Field bindweed have been documented within 1/4 mile of this species.			
Dwarf shrew	***Sorex nanus***	**G4 S4 Watchlist**	**none**		**1995**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Dalmatian toadflax and Canada thistle have been documented within 1/4 mile of this species.			
Wyoming pocket gopher	***Thomomys clusius***	**G2 S2**	**USFS, BLM**		**1912**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Field bindweed and Canada thistle have been documented within 1/4 mile of this species.			
Preble's meadow jumping mouse	***Zapus hudsonius preblei***	**G5T2 S1**	**T**		**2004**
Documented threats from noxious weeds None reported. But see Grunau et al. 2004 pg. 38		Potential threats from noxious weeds Field bindweed, Canada thistle, Dalmatian toadflax, Houndstongue, Hoary cress, and Leafy spurge have been documented within 1/4 mile of this species.			

1 Weeds documented at occurrence
2 Weeds documented within 1/4 miles of occurrence, or within 1 mile for elements with imprecise location.

Peterson Air Force Base

Peterson Air Force Base is located in El Paso County, Colorado, about seven miles east of downtown Colorado Springs. Elevations on the 1,294 acre base range from 6,140 to 6,280 feet. The

installation occupies gently sloping terrain that was historically comprised primarily of shortgrass prairie. The area experiences typical high plains weather, with a semi-arid climate and moderate temperatures. Average annual precipitation at the nearby Colorado Springs Weather Service Forecast Office is 16.1 inches, with about 65% being received during the months of May through August (Western Regional Climate Center 2006). Year-round temperatures are moderate; the annual mean temperature is 47.8 ºF. Average maximum summer temperatures are in the range of 79-85 ºF, while average winter minimums are 16.5-19 ºF (Western Regional Climate Center 2006). The majority of the base area is now developed, with vegetation consisting of a mosaic of highly managed turf, shrub and tree landscaping, interspersed with lower-maintenance areas of rock mulch or xeric grasses and native forbs. Native vegetation remnants persist in the relatively undeveloped Peterson East section, and consist of short- to mid-grass prairie grasses and forbs. This area is part of a Potential Conservation Area delineated by the Colorado Natural Heritage Program (Doyle et al. 2001) and supports a portion of a good (B-ranked) example of a globally- imperiled (G2 S2) big bluestem-prairie sandreed tallgrass community (*Andropogon gerardii-Calamovilfa longifolia*). The Peterson East section, however, does not represent the best part of this occurrence.

Ten noxious weed species have been documented at Peterson Air Force Base (Anderson et al. 2003, North Wind 2005e, Table 12). All of the weed infestations appear to be fairly small at this time except for Russian olive (5.6 acres mapped), Field bindweed (2.9 acres), and Canada thistle (1.9 acres, Anderson et al. 2003, North Wind 2005e). Canada thistle, Yellow toadflax, and Purple loosestrife are among the highest species targeted for control by El Paso County (El Paso County 2005). Field surveys are needed to determine whether or not these species (especially Canada thistle) threaten the significant plant community occurrence. The Purple loosestrife infestation has been eradicated but is the highest priority for management at this installation since monitoring is required for 15 years (Colorado Noxious Weed Act 2003). Canada thistle and Russian olive are also high priority species for management because they appear to be relatively easy to control at this time, and potentially threaten important natural resources at Peterson AFB. Other non-native plants known from Peterson AFB are listed in Appendix 5.

Table 12. Noxious weeds known from the Peterson AFB (North Wind 2005e). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plan (North Wind 2005e). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	**Scientific name**	**Invasiveness of species[2]**	**Total area mapped at installation (acres)**	**NatureServe management difficulty rank ---------- Feasibility of control[3]**	**Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.**
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	1.9	High/Medium ---------- Hard	High. Could threaten significant community occurrence. El Paso County goal is to suppress/contain.
Bull thistle	*Cirsium vulgare*	Medium/Low	< 0.1	Medium/Low	Medium. Small infestation, no intersection with significant plant community. However, infestation should be monitored to detect changes in occupied area or abundance.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank ---------- Feasibility of control[3]	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Field bindweed	*Convolvulus arvensis*	High/Medium	2.9	High/Medium ---------- Hard	Low. Difficult to control. No intersection with significant plant community.
Russian olive	*Elaeagnus angustifolia*	High/Medium	5.6	High ---------- Hard	High priority for elimination. Could threaten surrounding wetland areas, complete eradication from installation is possible (Anderson et al. 2003). No intersection with significant plant community.
Common St. Johnswort	*Hypericum perforatum*	High/Medium	<1	Medium	Medium. Small infestation, no intersection with significant plant community. However, infestation should be monitored to detect changes in occupied area or abundance.
Yellow toadflax	*Linaria vulgaris*	Medium/Low	< 0.1	High/Medium	Medium. Small infestation should be relatively easy to control (Anderson et al. 2003). No intersection with significant plant community. El Paso County goal is to suppress/contain.
Purple loosestrife	*Lythrum salicaria*	High	< 0.01	High	Very high priority for monitoring. State requires eradication. Small infestation should be relatively easy to control (Anderson et al. 2003). Potential intersection with significant plant communities. El Paso County goal is also for eradication. No biocontrol, and only control methods approved by commissioner. Monitor for at least 10 years (Colorado Noxious Weed Act 2003).
Bouncingbet	*Saponaria officinalis*	Unknown	< 0.01	Unknown	Low. However, infestation should be monitored to detect changes in occupied area or abundance.
Saltcedar	*Tamarix ramosissima*	High/Low	<1	High/Medium	Medium. Small infestation should be relatively easy to control (Anderson et al. 2003). No intersection with significant plant community.
Puncturevine	*Tribulus terrestris*	not ranked	<1	not ranked ---------- Easier	Medium. Small infestation, no intersection with significant plant community. However, infestation should be monitored to detect changes in occupied area or abundance.

1 North Wind 2005e.
2 following NatureServe Trend in Distribution Rank.
3 as detailed in plan and through personal communication.

One occurrence of a globally imperiled plant community has been documented at the Peterson Air Force Base (Table 13). Specific threats to this occurrence resulting from noxious weed infestations are not known. No weeds were noted within the occurrence when it was documented in 2000 (Colorado Natural Heritage Program 2006). GIS analyses indicate that Canada thistle may threaten the occurrence since an infestation of this noxious weed has been documented within ¼ mile (about 400 meters) of the mapped occurrence boundary.

Table 13. Rare species and significant plant communities known from the Peterson AFB (Colorado Natural Heritage Program 2006). Specific threats to these occurrences resulting from noxious weed infestations are not known. Analyses indicated that weeds may threaten occurrences because of their close proximity. Further details on Conservation status ranks are in Appendix 4.

MAMMALS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Black tailed prairie dog*	***Cynomys ludovicianus***	**G3G4 S3**			
Documented threats from noxious weeds[1] None reported		Potential threats from noxious weeds[2] Not analyzed because occurrence is just outside installation boundary			

PLANT COMMUNITIES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Big Bluestem - Prairie Sandreed Mesic Tallgrass Prairie	***Andropogon gerardii - Calamovilfa longifolia*** Herbaceous Vegetation	**G2 S2**			**2000**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Canada thistle appears to be within 1/4 mile of the occurrence.			

1 Weeds documented at occurrence.
2 Weeds documented within 1/4 miles of occurrence, or within 1 mile for elements with imprecise location.
*immediately adjacent to boundary.

Pinon Canyon Maneuver Site

Pinon Canyon Maneuver Site is located in Las Animas County, nearly 100 miles southeast of the city of Colorado Springs, and about 25 miles southwest of La Junta. Elevations at the site range from about 4,400 feet in the canyon bottom at the northeast boundary to over 5,800 feet on ridge tops near the southwest boundary. The 235,896 acre site includes extensive uplands and tributary drainages on the north side of the Purgatoire Canyon. This canyon system is the longest and deepest in eastern Colorado (Pague et al. 1995). The climate of the area is semi-arid. During the period 1948-1980, the average annual precipitation at the Doherty Ranch station (now part of the maneuver site) was 12.81 inches. For the period of record (1978-1993) at the Timpas station north of PCMS, average annual precipitation was 14.89 inches. About half of the yearly precipitation is received during the months of May through August (Western Regional Climate Center 2006). Winter average minimum temperatures are in the range of 16-20 ºF, and summer average maximum temperatures in July and August are near or above 90 ºF.

Shaw et al. (1989) characterized the vegetation at the site as a complex mosaic of grasslands, shrublands, and woodlands. Distribution of plant communities on the site is a result of a diversity of soils that have developed from sandstone, limestone, basalt, and shale parent materials, a complex topography, and the wide ecological amplitude of many of the component species. The extensive canyon of the Purgatorie and its tributaries, together with the associated uplands, bring together numerous elements from the Western Great Plains, the Rocky Mountain Foothills, and the Southern Rocky Mountains. Shaw et al. (1989) described 26 plant communities that include elements of shortgrass prairie, sandsage, greasewood, riparian and mixed saltbush shrublands, as well as juniper and riparian woodlands. A few rare examples of Ponderosa pine and aspen woodland communities are also present in the canyons. Wetland vegetation is uncommon and generally restricted to riparian

zones. Occasional springs or seeps occur and support isolated patches of wetland vegetation (Pague et al 1995). The remaining communities, including many unusual shrubland types, are characteristic of shale, limestone or sandstone cliffs, outcrops, breaks, and barrens throughout the the western great plains.

Sixteen noxious weed species have been documented at the Pinon Canyon Maneuver Site (DECAM 1999, Colorado Natural Heritage Program 2006, Rifici personal communication 2006, Table 14). African rue and Russian knapweed appear to be the highest priorities for management at this installation. The Colorado Noxious Weed Act (2003) requires that all infestations of African rue be eradicated. The small infestation at Pinon Canyon will require careful control measures since it potentially intersects occurrences of rare species and a significant plant association. Russian knapweed is particularly pervasive at Pinon Canyon, with 294 acres mapped to date (Rifici personal communication 2006). This species also has the potential to threaten occurrences of rare species and plant communities and control efforts should be focused at these locations. Hoary Cress, Canada thistle and Saltcedar are also high priorities for control. Canada thistle is only known from a small area at Pinon Canyon and it has been relatively easy to keep this species under control (Rifici personal communication 2006). Russian knapweed and Musk thistle are among the top species targeted for control by Las Animas County. Field surveys are needed to determine whether or not these species threaten occurrences of rare species or significant plant communities. The presence of Bull thistle at Pinon Canyon needs to be confirmed (Rifici personal communication 2006). Other non-native plants known from Pinon Canyon Maneuver Site are listed in Appendix 5.

Table 14. Noxious weeds known from the Pinon Canyon Maneuver Site (Rifici personal communication 2006, Colorado Natural Heritage Program 2006). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plans (DECAM 1999, Gene Stout and Associates 2006). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	**Scientific name**	**Invasiveness of species[2]**	**Total area mapped at installation (acres)**	**NatureServe management difficulty rank ---------- Feasibility of control[3]**	**Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.**
Common burdock (=Lesser burdock)	*Arctium minus*	High/Low	not mapped	Medium/ Insignificant	Very low, additional information is needed about the location and size of the infestations.
Russian knapweed	*Acroptilon repens (=Centaurea repens)*	High/Medium	294, major problem, large areas	High/Medium	Very High. Infestations of this species may threaten habitat for rare birds and mammals, Texas horned lizards, Juniper woodlands, Western wheatgrass mixed prairies, and the globally imperiled Arkansas Valley evening primrose. Listed as a high priority in draft management plan (Gene Stout and Associates 2006). On Las Animas County Noxious Weed List.
Cheatgrass	*Bromus tectorum (=Anisantha tectorum)*	Medium	not mapped	High/Medium	Medium in areas that support significant plant communities. Infestations of this species have been reported to occur within several significant plant associations.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank ---------- Feasibility of control[3]	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Hoary cress	*Cardaria draba*	not ranked	5	not ranked	High, especially in areas that support significant plant communities. Infestations could invade habitat for Black-tailed prairie dogs and Texas horned lizards, as well as high quality Juniper woodlands. At this time Hoary cress is primarily along roadsides previously treated for Russian knapweed*.
Musk thistle (species identification is in question*)	*Carduus nutans*	High/Medium	0.002	High/Medium	Low. Not known to be in close proximity to rare species or significant plant communities. On Las Animas County Noxious Weed List.
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	0.28	High/Medium ---------- Small infestations at Pinon have been successfully controlled by hand-pulling and spraying*	High. Not known to be in close proximity to rare species or significant plant communities. However, small infestations are relatively easy to control at this time (Rifici personal communication 2006). Listed as a high priority in the draft management plan (Gene Stout and Associates 2006).
Bull thistle	*Cirsium vulgare*	Medium/Low	not mapped, presence at Pinon needs to be confirmed*	Medium/Low	Medium. Not known to be in close proximity to rare species or significant plant communities. Inventory is needed to confirm the presence of this species at Pinon.
Poison hemlock	*Conium maculatum*	Medium/Low	not mapped	Low/ Insignificant	Very low, additional information is needed about the location and size of the infestations.
Field bindweed	*Convolvulus arvensis*	High/Medium	5 acres mapped to report for biocontrol effort*	High/Medium	Medium. Difficult to control. Potentially invading occurrences of Mountain Plover, Texas horned lizard, Swift fox, and Juniper woodlands. Field bindweed mites were found at the PCMS in spring 2007. Texas A&M is working to create a field insectary of the mites at PCMS*.
Russian olive	*Elaeagnus angustifolia*	High/Medium	not mapped, a few thousand plants*	High	High in areas outside the Cantonment. Low inside the Cantonment. Trees were planted in the mid 80's as part of a windbreak but have not spread far onto other areas of the base. Treatment of isolated trees outside the windbreak is planned for fall 2007*.
Redstem filaree	*Erodium cicutarium*	Medium/Low	not mapped	Medium/Low	Low.
Black henbane	*Hyoscyamus niger*	High/Low	not mapped	Medium/ Insignificant	Low.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank ---------- Feasibility of control[3]	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
African rue	*Peganum harmala*	not ranked	0.01	not ranked	Very High. However, African rue appears to be eradicated form the PCMS. Monitoring will continue for the next 8 years for species re-occurrence. Immediate treatment will occur on any plants found*. A management plan was developed for this species with Colorado Department of Agriculture in 2004*.
Saltcedar	*Tamarix ramosissima*	High/Low	87	High/Medium	High. An infestation of this species is known to occur within a Western wheatgrass mixed prairie occurrence, and is found in close proximity to habitat that supports Texas horned lizards, Dwarf milkweed, Arkansas Valley evening-primrose, Feruginous hawk, Mountain Plover, Bald Eagle, Black-tailed prairie dog, Swift fox, Juniper woodlands. However, Saltcedar is restricted to riparian habitats, and the significant natural resources listed above do not tend to use riparian areas. Listed as a high priority in the draft management plan (Gene Stout and Associates 2006).
Puncturevine	*Tribulus terrestris*	not ranked	not mapped	not ranked	Very low.
Common mullein	*Verbascum thapsus*	Medium	not mapped	Low	Very low, additional information is needed about the location and size of the infestations.

1 Shaw et al. 1989, Colorado Natural Heritage Program 2006, Rifici personal communication 2006.
2 following NatureServe Trend in Distribution Rank.
3 as detailed in plan and through personal communication. * Rifici personal communication 2006

Fourty-seven occurrences of 32 rare species or significant plant communities have been documented at the Pinon Canyon Maneuver Site (Table 15). Specific threats to these occurrences resulting from noxious weed infestations are not known. Some of the occurrence records for the significant plant communities report that Cheatgrass is invading the occurrence but that it is not likely to become problematic. GIS analyses indicated that Russian knapweed, Saltcedar, Field bindweed, and Hoary cress may threaten other occurrences since they are found within ¼-1 mile (about 0.4-1.6 kilometers) of mapped locations of weeds (Table 15).

Table 15. Rare species and significant plant communities known from the Pinon Canyon Maneuver Site
(Colorado Natural Heritage Program 2006, Klavetter personal communication 2007). Specific threats to these occurrences resulting from noxious weed infestations are not known. Analyses indicated that weeds may threaten occurrences because of their close proximity. Further details on Conservation Status ranks are in Appendix 4.

PLANTS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Fragrant indigobush (= Dwarf wild indigo)	***Amorpha nana***	**G5 S2S3**			**1997**

Documented threats from noxious weeds[1]	Potential threats from noxious weeds[2]
None reported	Unknown

Greene's milkweed (=Dwarf milkweed)	***Asclepias uncialis*** ssp**. *uncialis***	**G3G4T2T3 S2**	**BLM/USFS**		**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Saltcedar is mapped within 1/4 mile of occurrences, but is not likely to invade upland sites.			
Ebony Spleenwort	***Asplenium platyneuron***	**G5 S1**			**1985**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Round-leaf Four-o'clock	***Mirabilis rotundifolia (=Oxybaphus rotundifolius)***	**G2 S2**			**2006**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Star cloakfern = Standley's cloak fern	***Notholaena standleyi (=Cheilanthes standleyi)***	**G4 S1**			**1985**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Arkansas Valley evening-primrose	***Oenothera harringtonii***	**G2 S2**	**USFS**		**2006**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Saltcedar and Russian knapweed are mapped within 1/4 of occurrences. Saltcedar is not likely to impact this upland species.			
Single-head goldenweed (= Rayless goldenweed)	***Oonopsis foliosa*** var**. *monocephala***	**G2G3T2 S2**			**2006**
Documented threats from noxious weeds Russian knapweed, Hoary cress and Field bindweed are the most likely threats to this species.		Potential threats from noxious weeds Unknown			
Purple-stem cliffbrake (=Purple cliff-brake)	***Pellaea atropurpurea***	**G5 S2S3**			**1985**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Smooth cliffbrake	***Pellaea glabella*** ssp**. *simplex (=Pellaea suksdorfiana)***	**G5T4? S2**			**1985**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Wright's cliffbrake	***Pellaea wrightiana***	**G5 S2**			**1994**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Desert portulaca (= Dwarf purslane)	***Portulaca halimoides (=Portulaca parvula)***	**G5 S1**			**1986**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
New Mexico cliff fern	***Woodsia neomexicana***	**G4? S2**			**2000**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

BIRDS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Ferruginous Hawk	***Buteo regalis***	**G4 S3B,S4N**	**BLM/USFS**	**SC**	**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Russian knapweed and Saltcedar are mapped within 1/4 mile of occurrence.			
Mountain Plover	***Charadrius montanus***	**G2 S2B**	**BLM/USFS**	**SC**	**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Russian knapweed, Saltcedar, African rue, and Field bindweed are mapped within 1/4 mile of occurrences.			

Bald Eagle	***Haliaeetus leucocephalus***	**G5 S1B,S3N**	**LT, PDL**	**ST**	**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Russian knapweed and Saltcedar are mapped within 1/4 mile of occurrence.			
Lewis's Woodpecker	***Melanerpes lewis***	**G4 S4**	**USFS**		**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

AMPHIBIANS & REPTILES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Colorado checkered whiptail (=Triploid Colorado checkered whiptail)	***Aspidoscelis neotesselata***	**G2G3 S2**		**SC**	**2006**
Documented threats from noxious weeds An increased risk of fire due to noxious weed could have a negative impact on localized populations.		Potential threats from noxious weeds Unknown			
Canyon treefrog	***Hyla arenicolor***	**G5 S2**	**BLM**		**2000**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
New Mexico thread snake (Texas blind snake)	***Leptotyphlops dissectus***	**G4G5 S1**		**SC**	**2006**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Texas horned lizard	***Phrynosoma cornutum***	**G4G5 S3**	**BLM**	**SC**	**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Russian knapweed, Hoary cress, Field bindweed, Saltcedar, and African rue are mapped within 1/4 mile of occurrences.			
Plains leopard frog	***Rana blairi***	**G5 S3**	**BLM/USFS**	**SC**	**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

MAMMALS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Black-tailed prairie dog	***Cynomys ludovicianus***	**G3G4 S3**	**USFS**	**SC**	**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Russian knapweed, Hoary cress, and Saltcedar are mapped within 1/4 mile of occurrences.			
Swift fox	***Vulpes velox***	**G3 S3**	**USFS**	**SC**	**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Russian knapweed, Field bindweed, Saltcedar, and African rue are mapped within about 1 mile of occurrence.			

PLANT COMMUNITIES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Black Grama - Galleta Shortgrass Prairie	***Bouteloua eriopoda - Pleuraphis jamesii*** Herbaceous Vegetation	**G3 SU**			**2007**
Documented threats from noxious weeds Some exotic species in minor quantities, viability is moderate - exotics will be difficult to reduce because of natural disturbance.		Potential threats from noxious weeds Unknown			
Blue Grama - Galleta Shortgrass Prairie	***Bouteloua gracilis - Pleuraphis jamesii*** Herbaceous Vegetation	**G2G4 S3**			**2007**

Documented threats from noxious weeds Russian knapweed the single biggest threat to the community at this time*. Cheatgrass is widespread in part of one occurrence. Another occurrence is "in rather poor condition because of the abundance of exotic species that occur."		Potential threats from noxious weeds Unknown			
Foothills Pinyon-Juniper Woodland	***Juniperus monosperma- (Pinus edulis)/Cercocarpus montanus/ Schizachyrium scoparium*** Woodland	**GU SU**			**2007**
Documented threats from noxious weeds Unknown		Potential threats from noxious weeds Unknown			
One-seed Juniper / Black Grama Woodland = Juniper Woodland	***Juniperus monosperma / Bouteloua eriopoda*** Woodland	**GNR S2S3**			**2007**
Documented threats from noxious weeds Cheatgrass in valley flat below. This species could spread onto the surrounding slopes but probably will never become very common.		Potential threats from noxious weeds Russian knapweed, Hoary cress, Saltcedar, Field bindweed, African rue within 1/4 mile. However, Saltcedar and African rue pose no threat to this community*.			
One-seed Juniper / Blue Grama Woodland	***Juniperus monosperma / Bouteloua gracilis*** Woodland	**G5 S3S4**			**2007**
Documented threats from noxious weeds Lower valley has an old stockpond with a lot of Cheatgrass around and in small draws and ravines. This species could spread onto the surrounding slopes but probably will never become very common.		Potential threats from noxious weeds Unknown			
Scarp Woodland	***Juniperus scopulorum/ Cercocarpus montanus-Rhus trilobata*** Woodland	**GU SU**			**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Western Wheatgrass - Blue Grama Mixedgrass Prairie	***Pascopyrum smithii-Bouteloua gracilis*** Herbaceous Vegetation	**G5 S4 partial track**			**2007**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Western Wheatgrass Mixedgrass Prairie	***Pascopyrum smithii*** Herbaceous Vegetation	**G3G5Q S2**			**2007**
Documented threats from noxious weeds Saltcedar clumped here and there along the arroyo.		Potential threats from noxious weeds Russian knapweed and Saltcedar are mapped within 1/4 mile of occurrence.			
Black Greasewood / Alkali Sacaton Sparse Vegetation	***Sarcobatus vermiculatus / Sporobolus airoides*** Sparse Vegetation	**G3? S2**			**2007**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Unknown			

1 Weeds documented at occurrence
2 Weeds documented within 1/4 miles of occurrence, or within 1 mile for elements with imprecise location

Pueblo Chemical Depot

Pueblo Chemical Depot (PCD) is located in Pueblo County, Colorado, approximately 15 miles east of the city of Pueblo. The installation occupies nearly 23,000 acres of land about 1 mile to the north of the Arkansas River. Elevations range from 4,550 feet at Chico Creek (at the southwestern boundary of the depot) to 4,814 feet along the northern boundary of the site. The climate at PCD is typical of Colorado's eastern plains, and is characterized by relatively low humidity, abundant sunshine, low rainfall, and moderate to high winds (Western Regional Climate Center 2002). Much

of the annual precipitation falls in the summer during heavy thunderstorms. During the period 1961 through 1990 mean annual precipitation was 10.42 inches (24.69 cm) at PCD (Western Regional Climate Center 2006a). Long-term (1954-2005) data for the Pueblo Airport Weather Service Office indicate that the warmest months in the Pueblo area are June, July, and August, when the mean maximum daily temperature is near 90º F (87.3º F, 92.7º F, and 89.7º F, respectively). January is the coldest month with a mean daily high temperature of 45.9º F and mean nightly low temperature of 13.9º F (Western Regional Climate Center 2006b).

Vegetation at the Depot is characteristic of the high plains, and is a mosaic of shortgrass prairie, sandsage shrubland, greasewood shrubland, wetland and riparian vegetation, and disturbed landscape (Rondeau 2003). Shortgrass prairie is the most common vegetation type at PCD, covering nearly 11,500 acres, and primarily dominated by low-growing perennial grasses including blue grama (*Bouteloua gracilis =Chondrosum gracile*) and purple three-awn (*Aristida purpurea*). Sandsage habitats are found on sandy substrates where the sparse ground cover is dominated by sandsage (*Artemisia filifolia =Oligosporus filifolius*) with a mixture of grasses and forbs. The greasewood shrubland community is most prominent on the eastern portion of PCD, and is characterized by by the presence of greasewood (*Sarcobatus vermiculatus*); rabbitbrush (*Chrysothamnus nauseosus*) and cholla (*Cylindropuntia imbricata*) may also be present to co-dominant (Rondeau 2003).

Twelve noxious weed species have been documented at Pueblo Chemical Depot (Fayette Regier 2001, Canestorp personal communication 2006, Table 16). Saltcedar is the most pervasive and problematic species (Fayette Regier 2001, personal communication Rondeau 2006). It is a very high priority regionally to control infestations of Saltcedar because of its potential to compromise the viability of rare species and significant plant associations. Russian olive is also a very high priority because infestations of this species are small, and they are found in close proximity to nearly all of the rare species and significant plant communities. Canada thistle, Field bindweed, and Saltcedar are among the top species targeted for control by Pueblo County. Field surveys are needed to determine whether or not these species threaten the significant plant community occurrences. Other noxious weeds that have been documented at PCD are listed in Appendix 5.

Table 16. Noxious weeds known from Pueblo Chemical Depot (Fayette Regier 2001). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plan (not drafted for PCD). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Cheatgrass	*Bromus tectorum*	Medium	1472, however cover is sparse throughout PCD	High/Medium	Medium. Infestations have been documented in close proximity to occurrences of Plains leopard frog, Mountain Plover, Southern red-bellied dace, Black-tailed prairie dog, Colorado checkered whiptail, and four of the significant plant communities documented at PCD.
Chicory	*Chichorium intybus*	Medium/Low	negligible	High/Low	Medium. Small patch may be relatively easy to control.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	0.5	High/Medium	High. Infestations have been documented in close proximity to occurrences of Plains leopard frog, Southern red-bellied dace, Black-tailed prairie dog, and four of the significant plant communities.
Bull thistle	*Cirsium vulgare*	Medium/Low	Unknown†	Medium/Low	Very low. Additional information is needed about the location and management needs for this species at PCD.
Poison hemlock	*Conium maculatum*	Medium/Low	not mapped	Low/Insignificant	Very low, additional information is needed about the location and size of the infestations.
Field bindweed	*Convolvulus arvensis*	High/Medium	59	High/Medium	Medium. Infestations have been mapped in close proximity to occurrences of Southern red-bellied dace, Black-tailed prairie dog, and one significant plant community.
Fuller's teasel (= Common teasel)	*Dipsacus fullonum*	Medium	small patch	High/Low	Medium. Small patch may be relatively easy to control.
Russian olive	*Elaeagnus angustifolia*	High/Medium	a few scattered plants	High	Very high. Small infestations are found in close proximity to nearly all of the rare species and significant plant communities.
Quackgrass	*Elytrigia repens (=Agropyron repens)*	not ranked	not mapped	not ranked	Low.
Saltcedar	*Tamarix ramosissima*	High/Low	2,176	High/Medium	High at intersection with rare species and significant plant communities. Medium elsewhere. Large infestations will be difficult to control. However, infestations are found in close proximity to nearly all of the rare species and significant plant communities.
Puncturevine	*Tribulus terrestris*	not ranked	not mapped	not ranked	Low. Intersection with important natural resources is unknown.
Common mullein	*Verbascum thapsus*	Medium	472		Medium. Infestations are found in close proximity to occurrences of Plains leopard frog, and three significant plant communities.

1 Fayette Regier 2001, Colorado Natural Heritage Program 2006, Canestorp personal communication 2006)
2 following NatureServe Trend in Distribution Rank.
* Rondeau personal communication 2006
† reported in 1996 but not observed in 2000 or 2001 (Fayette Regier 2001)

A total of 22 occurrences of 13 significant plants, animals and plant associations have been documented at Pueblo Chemical Depot (Table 17, Colorado Natural Heritage Program 2006). GIS analyses indicated that weeds may threaten many of the occurrences since they are found within ¼-1 mile (about 0.4-1.6 kilometers) of mapped locations of weeds (Table 17).

Table 17. Rare species and significant plant communities known from the Pueblo Chemical Depot (Colorado Natural Heritage Program 2006). Specific threats to these occurrences resulting from noxious weed infestations are not known. Analyses indicated that weeds may threaten occurrences because of their close proximity. Further details on the Conservation Status ranks are in Appendix 4.

PLANTS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Sandhill goosefoot	***Chenopodium cycloides***	**G3G4 S1**	**USFS**		**2001**
Documented threats from noxious weeds[1] None reported.		Potential threats from noxious weeds[2] Saltcedar is mapped within 1/4 mile of this occurrence.			

BIRDS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Ferruginous Hawk	***Buteo regalis***	**G4 S3B,S4N**	**BLM/USFS**	**SC**	**2003**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Saltcedar and Russian olive are mapped within a 1/4-1 mile of the occurrences.			
Mountain Plover	***Charadrius montanus***	**G2 S2B**	**BLM/USFS**	**SC**	**2002**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Russian olive and Cheatgrass are mapped within 1/4-1 mile of the occurrences.			

AMPHIBIANS & REPTILES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Plains leopard frog	***Rana blairi***	**G5 S3**	**BLM/USFS**	**SC**	**2000**
Documented threats from noxious weeds Saltcedar is a concern for Plains leopard frog at PCD (Rondeau personal communication 2006).		Potential threats from noxious weeds Russian olive, Saltcedar, Common mullein, Cheatgrass, and Canada thistle are mapped within 1/4 mile of the occurrence.			
Colorado checkered whiptail (Triploid Colorado checkered whiptail)	***Aspidoscelis neotesselata***	**G2G3 S2**		**SC**	**2003**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Saltcedar and Cheatgrass are mapped within 1/4 mile of the occurrence.			
Massasauga	***Sistrurus catenatus***	**G3G4 S2**	**BLM/USFS**	**SC**	**2001**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Unknown.			

FISH

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Southern redbelly dace	***Phoxinus erythrogaster***	**G5 S1**	**USFS**	**SE**	**1993**
Documented threats from noxious weeds Canada thistle is particularly problematic for this species at PCD (Rondeau personal communication 2006).		Potential threats from noxious weeds Saltcedar, Russian olive, Field bindweed, Cheatgrass, and Canada thistle are mapped within 1/4 mile of the occurrences.			

MAMMALS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Black-tailed prairie dog	***Cynomys ludovicianus***	**G3G4 S3**	**USFS**	**SC**	**2002**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Saltcedar, Russian olive, Field bindweed, Cheatgrass, and Canada thistle are mapped within 1/4 mile of the occurrences.			

PLANT COMMUNITIES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Inland Saltgrass Saline Prairie	***Distichlis spicata*** Herbaceous Vegetation	**G5 S3**			**2000**
Documented threats from noxious weeds Occurrence record reports Saltcedar. However, weed control a low priority here (Rondeau personal communication 2006).		Potential threats from noxious weeds Saltcedar and Russian olive are mapped within a 1/4 mile of the occurrence.			
Plains Cottonwood/Western Wheatgrass-Vine Mesquite Woodland	***Populus deltoides / Pascopyrum smithii-Panicum obtusum*** Woodland	**G2 S2**			**2000**
Documented threats from noxious weeds Saltcedar ubiquitous.		Potential threats from noxious weeds Saltcedar, Cheatgrass, Common mullein, and Canada thistle are mapped within a 1/4 mile of the occurrence.			
Plains Cottonwood/Alkali Sacaton Woodland	***Populus deltoides / Sporobolus airoides*** Woodland	**G3 S2**			**2000**
Documented threats from noxious weeds Saltcedar ubiquitous.		Potential threats from noxious weeds Russian olive, Saltcedar, Cheatgrass, Common mullein, and Canada thistle are mapped within a 1/4 mile of the occurrence.			
Black Greasewood / Alkali Sacaton Sparse Vegetation	***Sarcobatus vermiculatus / Sporobolus airoides*** Sparse Vegetation	**G3? S2**			**2000**
Documented threats from noxious weeds Saltcedar reported.		Potential threats from noxious weeds Saltcedar, Russian olive, Common mullein, Field bindweed, Cheatgrass, and Canada thistle are mapped within a 1/4 mile of the occurrence.			
Bulrush Wet Meadow	***Schoenoplectus pungens*** Herbaceous Vegetation	**G3G4 S3**			**2000**
Documented threats from noxious weeds One occurrence reports Saltcedar, the other Canada thistle.		Potential threats from noxious weeds Saltcedar, Russian olive, Cheatgrass, and Canada thistle are mapped within a 1/4 mile of the occurrences.			

1 Weeds documented at occurrence
2 Weeds documented within 1/4 miles of occurrence, or within 1 mile for elements with imprecise location.

Schriever Air Force Base

Schriever Air Force Base is located in El Paso County, Colorado, about 10 miles east of the city of Colorado Springs. Developed areas at the 3,840 acre base are currently confined to a single square mile section. The remaining lands serve as a buffer around the developed area, and consist of rolling prairie sloping gently from northwest to southeast that varies in elevation from about 6,100 to 6,380 feet. Schriever AFB shares the fairly mild, semi-arid climate of the Front Range. The annual mean temperature is 47.8° F at the nearby Colorado Springs Airport Weather Service Office, and temperatures range from an average January minimum of 16.4°F to an average July maximum of 84.8°F. Annual precipitation is 16.1 inches, with the greatest monthly totals due to rainfall during the months of May through August (Western Regional Climate Center 2006).

Natural vegetation consists of plant communities typical of the shortgrass prairie of the Western Great Plains. Fayette et al. (2000b) described the upland landscape as dominated by blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloe dactyloides*), three-awned grass (*Aristida purpurea*), dropseed (*Sporobolus cryptandrus*), and needle-and-thread grass (*Stipa comata*). Natural depressional wetlands or playas are found within the rolling hills of shortgrass prairie in central El Paso County, and Schriever AFB contains several of these small, periodically inundated, closed

basins (Doyle et al. 2001). The playas support stands a rare plant community of western wheatgrass with mixed species of spikerush (*Pascopyrum smithii-Eleocharis* spp.).

Eight noxious weeds have been documented at Schriever AFB (North Wind 2005f). None of the infestations are very high priority for management on a regional level. Canada thistle, Field bindweed, and Russian olive are high priorities for management regionally where these species potentially threaten an occurrence of a playa grassland. Other noxious weeds that have been documented at Schriever AFB are listed in Appendix 5.

Table 18. Noxious weeds known from the Schriever AFB (North Wind 2005f). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plan (North Wind 2005f). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	**Scientific name**	**Invasiveness of species[2]**	**Total area mapped at installation (acres)**	**NatureServe management difficulty rank ---------- Feasibility of control[3]**	**Priority for management at installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.**
Cheatgrass	*Bromus tectorum*	Medium	46	High/Medium ---------- Hard	Low. Not on El Paso County weed list.
Musk thistle	*Carduus nutans*	High/Medium	16	High/Medium ---------- Easier	Medium. El Paso County goal is to suppress/contain.
Diffuse knapweed	*Centaurea diffusa*	High/Medium	21	High/Medium	Medium. El Paso County goal is to suppress/contain.
Spotted knapweed	*Centaurea maculosa*	High/Medium	15	High/Low ---------- Medium	Medium. No intersection with important natural resources. El Paso County goal is for eradication. Elimination is required in all counties except La Plata. Only management techniques approved by commissioner. No biocontrol. Monitor for 15 years (Colorado Noxious Weed Act 2003).
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	19	High/Medium ---------- Hard	High at intersection with significant plant community. Medium elsewhere. County goal is to suppress/contain.
Field bindweed	*Convolvulus arvensis*	High/Medium	83	High/Medium ---------- Hard	High at intersection with significant plant community. Low elsewhere. Not on El Paso County weed list.
Russian olive	*Elaeagnus angustifolia*	High/Medium	28	High ---------- Hard	High at intersection with significant plant community. Low elsewhere. Not on El Paso County weed list.
Puncturevine	*Tribulus terrestris*	not ranked	2.2	not ranked ---------- Easier	Medium. Not on El Paso County weed list.

1 North Wind 2005f
2 following NatureServe Trend in Distribution Rank
3 as detailed in plan and through personal communication

Three significant plants, animals and plant associations have been documented at the Schriever AFB (Table 19, Colorado Natural Heritage Program 2006). Plains ragweed is a globally rare species known only from the Great Plains of Colorado. This species occurs in playas on the prairie. Additionally, it may grow in artificial habitats which mimic the hydrologic setting of a playa, i.e. seasonal moisture with limited vegetation. This occurrence falls into this latter category. Approximately 1000 individuals occur on a man-made berm on the south-side of a natural depression. The natural depression may have included potential habitat for this species prior to the construction of the berm. The surrounding prairie is in fair condition and is largely undeveloped. There are several other man-made and natural playas on Schriever AFB but they were not found to support the plains ragweed (Fayette et al. 2000b).

Table 19. Rare species and significant plant communities known from the Schriever AFB (Colorado Natural Heritage Program 2006). Specific threats to these occurrences resulting from noxious weed infestations are not known. Analyses indicated that weeds may threaten occurrences because of their close proximity. Further details on the Conservation Status ranks are in Appendix 4.

PLANTS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Plains ragweed (=Linear-leaf bursage)	***Ambrosia linearis***	**G3 S3**			**2000**
Documented threats from noxious weeds[1] Occurrence record mentions many weeds, only Cheatgrass is state noxious.		Potential threats from noxious weeds[2] Scotch thistle intersects, however, this species is not listed in North Wind 2005f, where the weed data came from.			

INSECTS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Simius roadside skipper	***Amblyscirtes simius***	**G4 S3**			**1986**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Unknown			

PLANT COMMUNITIES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Western Wheatgrass - Spikerush Mixedgrass Prairie (Playa)	***Pascopyrum smithii* - *Eleocharis*** spp. Herbaceous Vegetation	**G2 S2**			**2000**
Documented threats from noxious weeds None reported.		Potential threats from noxious weeds Field bindweed, Canada thistle, Russian olive are mapped within 1/4 mile of the occurrence.			

1 Weeds documented at occurrence.
2 Weeds documented within 1/4 miles of occurrence, or within 1 mile for elements with imprecise location.

U.S. Air Force Academy and Farish Outdoor Recreation Area

The U. S. Air Force Academy (USAFA) is located in El Paso County, Colorado, on the northern edge of the city of Colorado Springs. The 18,455 acre installation lies at the foot of the Rampart Range, and encompasses a variety of terrain from mountain slopes to gently sloping alluvial foothills of the Colorado Piedmont. Between these western and eastern extremes lies a diverse landscape of mesas, ridges, and valleys (Anderson et al. 2003). The climate of the area is continental and semi-arid. Ripley (1994) reported that annual precipitation recorded at the Academy airfield averages

17.4 in (44.3 cm), with the greatest monthly totals due to late spring and summer thunderstorms. Average monthly temperatures recorded at the airfield range from 68.1 deg F (20 deg C) in July to 29.5 deg F (-1.4 deg C) in January (Ripley, 1994).

A total of 25 noxious weeds have been documented at the U. S. Air Force Academy (Ripley 1994, Anderson et al. 2003, Carpenter et al. 2004). The highest priorities for management on a regional scale are Spotted knapweed, Leafy spurge, and Myrtle spurge. All of the infestations of these weed species are fairly small at this time, the species are highly invasive, and have the potential to threaten important natural resources. Other non-native plants that have been documented at the Academy are listed in Appendix 5.

Table 20. Noxious weeds known from the U. S. Air Force Academy (Anderson et al. 2003, Carpenter et al. 2004). The priority for management is intended to reflect a regional priority for all weed infestations found at all of the Front Range military installations. This information is not intended to replace the individual installation Invasive Species Control Plan (Carpenter et al. 2004). Further details on the NatureServe ranks are in Appendix 4.

Noxious weed species known from installation[1]	**Scientific name**	**Invasiveness of species[2]**	**Total area mapped at installation (acres)**	**NatureServe management difficulty rank ---------- Feasibility of control[3]**	**Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.**
Russian knapweed	*Acroptilon repens (=Centaurea repens)*	High/Medium	Low abundance* not mapped	High/Medium ---------- High	High for elimination. Small infestation. No intersection with important natural resources. El Paso County goal is to suppress/contain.
Common burdock	*Arctium minus*	High/Low	not mapped	Medium/ Insignificant	Low. Intersection with important natural resources is unknown. Not on El Paso County Weed List.
Cheatgrass	*Bromus tectorum (=Anisantha tectorum)*	Medium	not mapped	High/Medium	Low. Not on El Paso County weed list
Hoary cress	*Cardaria draba*	not ranked	3.58	not ranked ---------- Hard	High for elimination/containment. Small infestation with intersection with important natural resources. Not on El Paso County weed list.
Musk thistle	*Carduus nutans*	High/Medium	16.16 + 0.85 at Farish	High/Medium ---------- Medium	High for elimination at intersection with important natural resources, containment elsewhere. El Paso County goal is to suppress/contain.
Diffuse knapweed	*Centaurea diffusa (=Acosta diffusa)*	High/Medium	56.41	High/Medium ---------- Medium	High for elimination at intersection with important natural resources, containment elsewhere. El Paso County goal is to suppress/contain.
Spotted knapweed	*Centaurea maculosa (=Acosta maculosa)*	High/Medium	4.68 now much more, pop-ulation has exploded since 2002**	High/Low ---------- Not rhizomotous so easier to control**	Very High. Relatively small infestation near important natural resources. El Paso County goal is for eradication.
Chicory	*Cichorium intybus*	Medium/Low	not mapped	High/Low	Low.

Noxious weed species known from installation[1]	**Scientific name**	**Invasiveness of species[2]**	**Total area mapped at installation (acres)**	**NatureServe management difficulty rank ---------- Feasibility of control[3]**	**Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.**
Canada thistle	*Cirsium arvense (=Breea arvensis)*	Medium/Low	101.43 + 0.23 at Farish	High/Medium ---------- Hard	High for elimination at intersection with important natural resources, containment elsewhere. County goal is to suppress/contain.
Bull thistle	*Cirsium vulgare*	Medium/Low	5.54	Medium/Low ---------- Easier	Medium. No intersecton with natural resources. Not on El Paso County weed list.
Poison hemlock	*Conium maculatum*	Medium/Low	not mapped	Low/ Insignificant	Very low, additional information is needed about the location and size of the infestations.
Field bindweed	*Convolvulus arvensis*	High/Medium	not mapped	High/Medium ---------- Hard	Low. Not on El Paso County weed list.
Fuller's teasel	*Dipsacus fullonum*	Medium	18.34	High/Low ---------- Medium	High for elimination at intersection with important natural resources, containment elsewhere. Not on El Paso County weed list.
Russian olive	*Elaeagnus angustifolia*	High/Medium	49.79 (73% has been eradicated[†]	High ---------- Easier	High for elimination. Intersection with natural resources. Not on El Paso County weed list.
Quackgrass	*Elytrigia repens*	not ranked	not mapped	not ranked	Low. Intersection with important natural resources is unknown.
Redstem filaree	*Erodium cicutarium*	Medium/Low	not mapped	Medium/Low	Low. Intersection with important natural resources is unknown.
Leafy spurge	*Euphorbia esula (=Tithymalus esula)*	High/Low	1.09 + a small amount at Farish	High ---------- Medium	Very High. Relatively small infestation near important natural resources. El Paso County goal is to suppress/contain.
Myrtle spurge	*Euphorbia myrsinites*	High/Low	Small area	High/Low	Very high. A list species in Colorado, eradication is required by State Dept. of Agriculture. Intersection with Preble's meadow jumping mouse habitat. However, this species is not currently threatening the mouse habitat (Mihlbachler personal communication 2006).
Common St. Johnswort	*Hypericum perforatum*	High/Medium	<0.1 ; 3 infestations	Medium ---------- Medium	High. Small infestations should be relatively easy to control. Intersection with Rocky Mountain cinquefoil. Not on El Paso County weed list.
Yellow toadflax	*Linaria vulgaris*	Medium/Low	102.93 + 5.25 at Farish	High/Medium ---------- Hard	High for suppression/reduction at intersection with important natural resources. Low elsewhere. El Paso County goal is to suppress/contain.
Scotch thistle	*Onopordum acanthium*		.17	Not ranked ---------- Easier	Medium. Small infestation with no intersection with natural resources. Not on El Paso County weed list.
Wild proso millet	*Panicum miliaceum*	not ranked	not mapped	not ranked	Very Low.

Noxious weed species known from installation[1]	Scientific name	Invasiveness of species[2]	Total area mapped at installation (acres)	NatureServe management difficulty rank ---------- Feasibility of control[3]	Priority for management installation, and brief justification based on invasiveness of species, severity of infestation, feasibility of control, and location of infestation.
Bouncingbet	*Saponaria officinalis*	Unknown	not mapped	Unknown	Very Low.
Saltcedar	*Tamarix ramosissima*	High/Low	single individual at the Academy was destroyed*	High/Medium	High for monitoring.
Common mullein	*Verbascum thapsus*	Medium	not mapped	Low	Low. Not on El Paso County weed list

1 Ripley 1994, Anderson et al. 2003, Carpenter et al. 2004.
2 following NatureServe Trend in Distribution Rank.
3 as detailed in plan and through personal communication.
*Carpenter et al. 2004.
**Anderson personal communication 2006.
†Anderson and Lavender 2006.

At least 30 significant plants, animals and plant associations have been documented at the U. S. Air Force Academy (Table 21, Colorado Natural Heritage Program 2006). Nearly all of these important natural resources appear to be potentially threatened by noxious weeds. GIS analyses indicated that most of the rare species and significant plant associations are found within ¼-1 mile (about 0.4-1.6 kilometers) of mapped locations of noxious weeds (Table 21).

Table 21. Rare species and significant plant communities known from the U. S. Air Force Academy (Armstrong and Stevens 2002, Anderson and Lavender 2006, Colorado Natural Heritage Program 2006). Analyses indicated that weeds may threaten occurrences because of their close proximity. Further details on Conservation Status ranks are in Appendix 4.

PLANTS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
American currant (= Wild black currant)	***Ribes americana***	**G5 S2**			**2006**
Documented threats from noxious weeds[1] None reported		Potential threats from noxious weeds[2] Fuller's teasel, Diffuse knapweed, Canada thistle, Russian olive have been documented within 1/4 mile of this occurrence.			
Dwarf wild indigo (= Fragrant indigobush)	***Amorpha nana***	**G5 S2S3**			**1993**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Canada thistle, Yellow toadflax, Musk thistle, Fuller's teasel, and Russian olive are mapped within 1/4 mile of the occurrence.			
Prairie violet	***Viola pedatifida***	**G5 S2**			**1980**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Musk thistle, Yellow toadflax, Leafy spurge, Russian olive, Spotted knapweed, Diffuse knapweed, Fuller's teasel, and Canada thistle have been mapped within 1 mile of this imprecisely mapped occurrence.			

Porter's feathergrass	***Ptilagrostis porteri***	**G2 S2**	**BLM/USFS**		**2000**
Documented threats from noxious weeds Canada thistle is not within occurrence boundary but is a potential threat.		Potential threats from noxious weeds Musk thistle, Yellow toadflax, and Canada thistle have been mapped within 1/4 mile of this occurrence.			
Southern Rocky Mountain cinquefoil	***Potentilla ambigens***	**G3 S1S2**			**2006**
Documented threats from noxious weeds Yellow toadflax, Canada thistle, Musk thistle, and Common St. Johnswort are found within occurrences of this species.		Potential threats from noxious weeds Spotted knapweed, Diffuse knapweed, Musk thistle, Leafy spurge, Yellow toadflax, Russian olive, Fuller's teasel, and Canada thistle have been documented within 1/4 mile of this species.			
Grassy slope sedge	***Carex oreocharis***	**G3 S1**			**2000**
Documented threats from noxious weeds Yellow toadflax is a potential threat.		Potential threats from noxious weeds Musk thistle and Yellow toadflax have been mapped within 1/4 mile of this occurrence.			
Richardson's alumroot	***Heuchera richardsonii***	**G5 S1**			**1989**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Leafy spurge, Canada thistle, Diffuse knapweed, Spotted knapweed, Yellow toadflax have been mapped within 1/4 mile of this occurrence.			
Strap-style gayfeather (= Gayfeather)	***Liatris ligulistylis***	**G5? S1S2**			**2002**
Documented threats from noxious weeds Canada thistle is found with this species.		Potential threats from noxious weeds Yellow toadflax, Musk thistle, Canada thistle, Russian olive, Diffuse knapweed, Spotted knapweed, and Fuller's teasel have been mapped within 1/4 mile of this occurrence.			
New Mexico cliff fern	***Woodsia neomexicana***	**G4? S2**			**1989**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Yellow toadflax, Canada thistle, Diffuse knapweed, Musk thistle, Russian olive, Spotted knapweed, and Hoary cress have been documented within 1/4 mile of the occurrences.			
Plains ironweed	***Vernonia marginata***	**G5? S1**			**2005**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

BIRDS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Evening Grosbeak	***Coccothraustes vespertinus***				
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Ovenbird	***Seiurus aurocapilla***	**G5 S2B**			**1994**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Canada thistle and Yellow toadflax have been documented within 1/4 mile of this occurrence.			

INSECTS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Morrison's skipper	***Stinga morrisoni***	**G4G5 S3S4**			
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Moss's elfin (=Schryver's elfin)	***Callophrys mossii schryveri***	**G4T3 S2S3**			**1994**
Documented threats from noxious weeds Cheatgrass is present and may be a threat to the host plant, especially following ground disturbance.		Potential threats from noxious weeds Leafy spurge, Yellow toadflax, and Musk thistle have been mapped within 1/4 mile of this occurrence.			
Snow's skipper	***Paratrytone snowi***	**G5 S3**			
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			

Sedge darner	***Aeshna juncea***	**G5 S3**			
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Crossline skipper*	***Polites origenes***	**G5 S3**			**1974**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Canada thistle, Musk thistle, Yellow toadflax have been mapped within 1 mile of the occurrence.			
Hops azure (= Hops feeding azure)	***Celastrina humulus***	**G2G3 S2**			**1995**
Documented threats from noxious weeds Canada thistle documented at both occurrences.		Potential threats from noxious weeds Yellow toadflax, Russian olive, Canada thistle, Diffuse knapweed, Musk thistle, Fuller's teasel, Hoary cress, and Spotted knapweed have been mapped within 1/4 mile of the occurrences.			

MAMMALS

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Merriam's shrew	***Sorex merriami***	**G5 S3**			
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Unknown			
Preble's meadow jumping mouse	***Zapus hudsonius preblei***	**G5T2 S1**	**LT, PDL**	**ST**	**2005**
Documented threats from noxious weeds Canada thistle and Yellow toadflax have been reported within occurrences.		Potential threats from noxious weeds Canada thistle, Diffuse knapweed, Musk thistle, Spotted knapweed, Myrtle spurge, Leafy spurge, Russian olive, Yellow toadflax, Fuller's teasel, and Hoary cress have been documented within 1/4 mile of the occurrences.			

PLANT COMMUNITIES

Common name	Scientific name	Conservation status rank	Federal Status	State status	Last documented
Montane grassland = Parry oatgrass and xeric tall grass prairie	***Danthonia paryi*** herbaceous vegetation	**G3 S3**			**1996**
Documented threats from noxious weeds Yellow toadflax is invading in spots.		Potential threats from noxious weeds Musk thistle, Canada thistle, and Yellow toadflax have been mapped within 1/4 mile of this plant association.			
Thinleaf Alder-Red-osier Dogwood Riparian Shrubland	***Alnus incana/Cornus sericea*** shrubland	**G3G4 S3**			**1995**
Documented threats from noxious weeds Russian olive documented in occurrence record.		Potential threats from noxious weeds Diffuse knapweed, Canada thistle, Yellow toadflax, Musk thistle, Russian olive, and Hoary cress have been documented within 1/4 mile of this plant association.			
Montane Riparian Shrubland	***Alnus incana/*** mesic graminoid	**G3 S3**			**1995**
Documented threats from noxious weeds Russian olive has been reported with occurrences of this plant association.		Potential threats from noxious weeds Diffuse knapweed, Yellow toadflax, Russian olive, Musk thistle, Canada thistle, Fuller's teasel, and Hoary cress have been documented within 1/4 mile of this association.			
Narrowleaf Cottonwood Riparian Forests	***Populus angustifolia / Salix exigua*** woodland	**G4 S4 partial**			**1995**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Yellow toadflax, Canada thistle, Diffuse knapweed, Musk thistle, Russian olive, and Hoary cress have been documented within 1/4 mile of this association.			

Western Snowberry Shrubland	***Symphoricarpos occidentalis*** shrubland	**G4G5 S3 partial**			**1995**
Documented threats from noxious weeds Russian olive reported in relation to occurrences.		Potential threats from noxious weeds Diffuse knapweed, Spotted knapweed, Yellow toadflax, Canada thistle, Musk thistle, Russian olive, and Fuller's teasel have been documented within 1/4 mile of this plant association.			
Sandbar Willow / Mesic Graminoids Shrubland	***Salix exigua* /** mesic graminoids shrubland	**G5 S5 partial**			**1995**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Musk thistle, leafy spurge, Yellow toadflax, Diffuse knapweed, Spotted knapweed, Canada thistle, Russian olive, Fuller's teasel, and Hoary cress have been documented within 1/4 mile of this plant association.			
Foothills Ponderosa Pine Scrub Woodlands	***Pinus ponderosa/Quercus gambelii***	**G5 S4 partial track**			**1995**
Documented threats from noxious weeds None reported		Potential threats from noxious weeds Yellow toadflax, Canada thistle, Musk thistle, Diffuse knapweed, and Spotted knapweed have been documented within 1/4 mile of this association.			

*imprecise locaton – may be outside installation boundaries.
1 Weeds documented at occurrence.
2 Weeds documented within 1/4 miles of occurrence, or within 1 mile for elements with imprecise location.

Recommendations

Planning

Follow the installation-specific invasive species management plans. If such a plan is not available, one should be developed as soon as possible. For all installations, invasive species management plans should be continually revised as new information becomes available.

Implementation

Information gathering and management

Continue to map and document noxious weed locations. Base-wide surveys should be conducted at least every five years.

Collect new information using standardized methods. This will help with coordination among the regional military installations. Data standards to consider are:

- North American Weed Management Association: North American Invasive Plant Mapping Standards
- The Nature Conservancy's Weed Information Management System (WIMS)
- Spatial Data Standards for Facilities Infrastructure and Environment (SDSFIE)
- Federal Geographic Data Committee (FGDC) standards for geospatial data

Best Management Practices

- Work to control the highest priority infestations, using appropriate methods. Boom sprayers do not usually provide adequate targeted application for eradication within occurrences of rare plants, therefore all high priority infestations should be treated with a wick, which allows treatment of one plant at a time.

- Be proactive by controlling rare weeds immediately.
- Prevent new infestations of noxious weeds by using Best Management Practices such as:
  - Limiting soil disturbance. Disturbances many open habitat for new weeds. Use low impact methods that don't cause ground disturbance, such as walking through an occurrence to apply herbicide to individual weeds. Hand pulling weeds may cause soil disturbance and therefore may not be an optimal weed control method in some areas.
  - Washing vehicles and equipment prior to use on installations. Monitor compliance with this requirement in order to prevent the transport of weed seeds from infested areas.
  - Using certified weed-free native grasses for re-seeding.
- Avoid impacts to significant natural resources such as rare plant and animal occurrences and locations of significant plant communities. For example, herbicides could negatively impact host plants for rare butterflies, etc. Take note of rare species locations and avoid vehicular or other impacts to that species.
- Weed control methods should include the protection of natural resources and restoration of natural habitats, in addition to focusing on weed control. Ensure that anyone involved in weed control efforts on the installation is aware that management goals are different when treating weeds within rare species or significant natural community occurrences (e.g., conservation and restoration vs. simple weed control).
- Provide a thorough briefing for contractors who will be doing weed control work. Review natural resource information, including species identification (both weeds and rare species), the location of the significant natural resources and noxious weeds (use maps), and the caution required in treating weed infestations in these locations.

Cultivating success

Weed awareness

- The key to weed control success is to be observant and adaptable. Monitor and observe how weeds are responding to control efforts, and adjust as necessary. Conduct surveys to assure detection of new weeds and/or previously undocumented infestations. Because healthy native plant communities are the first line of defense against the invasion of noxious weeds, it is important to monitor the status of natural resource and other values.
- Stay informed. Learn about potential infestations by coordinating with state and county agencies (see Colorado and Wyoming statewide noxious weed lists in Appendixes 1 and 2, county noxious weed lists in Appendix 3, and lists of other non-natives known from each installation in Appendix 5).
- Be aware of non-native plants that are not listed as noxious, but that may be present in the area. Identify and watch for non-native species that are present on installations outside the ecoregion that could be transported to Colorado or Wyoming by movement of materiel or personnel.
- Cultivate a culture of success instead of creating job security for weed controllers. Develop performance standards for weed controllers.

Cooperation

- Communicate frequently and coordinate with county and state weed managers and other cooperative efforts, including adjacent landowners. Provide pictures of the noxious weeds and significant natural resources, establish cooperative management agreements, share equipment, share information about good contractors, good classes, etc.

- Bring the counties where the bases are located into discussions of priority infestations and other weeds species of concern. Work with counties on early detection and rapid response to priority infestations. Hold annual weed meetings with the counties and military installations.
- Involve state weed board representatives in decision-making and meetings.
- Consider developing a cooperative agreement with all of the bases, counties, and the two states.

Ongoing Monitoring

- Monitor weed control efforts, and re-survey for new infestations.
- One approach to a successful monitoring strategy is reported in Carpenter et al. (2004). These methods were implemented at the U.S. Air Force Academy by Anderson and Lavender (2006) and are worthy of consideration at other installations.
- Monitor occurrences of rare species and significant plant associations, paying special attention to specific threats to these elements posed by noxious weed invasions.

Continued planning

- Revise this plan as new information becomes available.
- Explore opportunities for sharing of resources, contracts, equipment, and personnel, i.e., hiring crews to go to all facilities, similar to Texas A&M biocontrol work and the TAMU biological control program.
- Continue to hold weed "roundtable" meetings as part of the Front Range Eco-regional Partnership to ensure coordination.
- Explore the possibility of having a Front Range DoD weed "czar" to take the lead on coordination (where applicable) on the priorities in this plan, and to serve as a liaison and point of contact with the State weed coordinator(s) and with regional efforts. Make sure it can be part of their official job duties. Explore use of Legacy funds for that person's time.
- Formalize participation in regional or local weed cooperatives/groups to facilitate more efficient and effective control and sharing of resources.

References

Anderson, D.G., A. Lavender, and R. Abbott. 2003. Noxious Weed Survey of the U. S. Air Force Academy and Farish Outdoor Recreation Area. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Anderson, D.G. 2006. Personal communication with Colorado Natural Heritage Program Botany Team Leader regarding the location and condition of rare species and weed infestation at the U. S. Air Force Academy.

Anderson, D.G. and A. Lavender. 2006. Noxious weed monitoring at the U. S. Air Force Academy-year 1 results. Prepared for the U. S. Air Force Academy Department of Natural Resources by the Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Armstrong, J. and J. Stevens. 2002. Monument Creek Watershed Landscape Assessment- a Legacy Resource Management Program Project. Prepared for U. S. Air Force Academy by the Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Barlow, M.M., and D.H. Knight. 1999. Historic vegetation of the F.E. Warren Air Force Base, Wyoming. Department of Botany, University of Wyoming, Laramie, WY.

Canestorp. M. 2006. Personal communication with U.S. Fish and Wildlife Service Biologist regarding noxious weeds at Pueblo Chemical Depot.

Carpenter, A.T., S.G. Perce, M. Schmidt, and N. Lovell. 2004. Integrated noxious weed management plan U. S. Air Force Academy and Farish Outdoor Recreation Area, El Paso, Colorado. Unpublished report prepared by Land Stewardship consulting, Inc. in collaboration with URS, Inc.

CEMML – Center for Ecological Management of Military Lands. 1995. Vascular plant list of F.E. Warren Air Force Base, Laramie County, Wyoming. Center for Ecological Management of Military Lands, Department of Forest Sciences, Colorado State University, Fort Collins, CO.

Colorado Natural Heritage Program. 2006. Biodiversity Tracking and Conservation System. Colorado State University, Fort Collins, Colorado.

Colorado Noxious Weed Act. 2003. Title 35: Agriculture, Article 5.5: Colorado Noxious Weed Act, and 8 CCR 1203-19 Rules pertaining to the administration and enforcement of the Colorado Noxious Weed Act.

DECAM. 1999. Noxious Weed Management Plan for Fort Carson Military Reservation and Pinon Canyon Maneuver Site. Unpublished report provided by Caron Rifici, Fort Carson, Colorado.

Department of the Army, Fort Carson, Colorado. 1980. Draft Environmental Impact Statement for the Continuing Operation of Fort Carson. Prepared under the direction of Fort Carson's Environmental Quality Office in consultation with Higgenbotham and Associates AIA under contract (No. DACA 45-79-C-0037) to the U.S. Army Corps of Engineers, Omaha District.

Doyle, G., J. Armstrong, J. Gionfriddo, D.G. Anderson, J. Stevens, and R. Schorr. 2001. Survey of Critical Biological Resources, El Paso County, Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

El Paso County. 2005. Draft undesirable plant management plan. Unpublished report prepared by the El Paso County Environmental Services Department, Colorado Springs, CO.

Fahnestock, J. 2006. Personal communication with North Wind Biologist regarding noxious weeds at the Front Range military installations.

Fayette, K., R. Schorr, D. Anderson, and E. Mohr. 2000a. Natural History Inventory of Buckley Air National Guard Base, Arapaho County, Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Fayette, K., D. Anderson, E. Mohr, and J. Gionfriddo. 2000b. Natural Heritage Inventory of Schriever Air Force Base, El Paso County, Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Fayette Regier, K. 2001. Pueblo Chemical Depot Noxious Weed mapping. Unpublished report prepared for Pueblo Chemical Depot, US Department of the Army, by the Colorado Natural Heritage Program.

Klavetter, M.L. 2007. Personal communication with Wildlife Biologist at the Pinon Canyon Maneuever Site.

Franklin, S. 2006. Personal communication with Wyoming Weed and Pest Coordinator regarding priorities for noxious weed control at F. E. Warren AFB in Wyoming.

Gene Stout and Associates. 2006 Draft. 7th Infantry Division and Fort Carson Draft Integrated Natural Resource Management Plan and Environmental Assessment 2007-2011. Natural and Cultural Resources Division Directorate of Environmental Compliance and Management, U.S. Department of Defense.

Grunau, L., R. Schorr, and J. Handwerk. 2004. Conservation and Management Plan for Colorado Butterfly Plant and Preble's Meadow Jumping Mouse on F.E. Warren Air Force Base. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Hiebert, R.D. and J. Stubbendieck. 1993. Handbook for ranking exotic plants for management and control. U.S. National Park Service Natural Resources Report NPS/MRMWRO/NRR-93/08.

Kettler, S. 2006. Personal communication with US Fish and Wildlife Service Biologist regarding noxious weed infestation on the Front Range military installations.

Lane, E. 2001. Colorado's strategic plan to stop the spread of noxious weeds: a framework for the statewide coordinated and cost-effective action to protect agriculture and the environment.

Lane, E. 2006. Personal communication with Colorado State Weed Coordinator regarding noxious weed infestation on the Front Range military installations and the Colorado state-wide noxious weed strategic plan.

Mihlbachler, B. 2006. Personal communication with U.S. Fish and Wildlife Service Range and Wildlife Biologist at the U. S. Air Force Academy regarding weed management requirements.

Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available online at: http://www.natureserve.org/explorer.

North Wind, Inc. 2005a. Air Force Space Command (AFSPC) summary report, invasive plant species and control recommendation for 15 AFSPC Installations. Unpublished report prepared for Air Force Space Command, Peterson Air Force Base, Colorado.

North Wind, Inc. 2005b. Invasive plant species control plan for Buckley Air Force Base, Colorado. Unpublished report prepared for Air Force Space Command, Peterson Air Force Base, Colorado.

North Wind, Inc. 2005c. Invasive plant species control plan for Cheyenne Mountain Air Force Station, Colorado. Unpublished report prepared for Air Force Space Command, Peterson Air Force Base, Colorado.

North Wind, Inc. 2005d. Invasive plant species control plan for F. E. Warren Air Force Base, Wyoming. Unpublished report prepared for Air Force Space Command, Peterson Air Force Base, Colorado.

North Wind, Inc. 2005e. Invasive plant species control plan for Peterson Air Force Base, Colorado. Unpublished report prepared for Air Force Space Command, Peterson Air Force Base, Colorado.

North Wind, Inc. 2005f. Invasive plant species control plan for Schriever Air Force Base, Colorado. Unpublished report prepared for Air Force Space Command, Peterson Air Force Base, Colorado.

Pague, C., A. Ellingson, S. Kettler, S. Spackman, and S. Simonson. 1995. Sensitive Species and Natural Communities Known to Occur on the Picket Wire Canyonlands, Comanche National Grassland, Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Rifici, C. 2006. Personal communication with natural resource manager for Fort Carson Military Reservation and Pinon Canyon Maneuver Site.

Ripley, J.D. 1994. Vegetation of the United States Air Force Academy and the Adjacent Regions of the Pike National Forest, El Paso County, Colorado. Department of Biology, U. S. Air Force Academy, Colorado Springs, CO. 423pp.

Rondeau, R. Personal communication with Colorado Natural Heritage Program Director/Chief Scientist regarding the distribution of noxious weeds and significant natural resources at Pueblo Chemical Depot.

Rondeau, R. 2003. Vegetation monitoring at Pueblo Chemical Depot, 1998-2003. Unpublished report prepared by the Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Schorr, R. and R. Abbott. 2004. Natural Heritage Inventory of Rare Plants, Animals and Plant Communities on Peterson Air Force Base, Colorado Springs, Colorado, Update to Final Report 1997. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Schuerman, T.P., C. De Leo, and D. Culver. 1997. Natural Heritage Inventory of the Rare Plants, Significant Natural Communities, and Animals of Peterson Air Force Base, Colorado Springs, Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Shaw, R.B., S.L. Anderson, K.A. Schulz, V.E. Diersing. 1989. Plant communities, ecological checklist, and species list for the U.S. Army, Pinon Canyon Maneuver Site, Colorado. Colorado State University, Department of Range Science, Science Series No. 37. Fort Collins, Colorado.

Sheley, R.L. and J.K. Petroff (eds.). 1999. Biology and Management of Noxious Rangeland Weeds. Corvallis, Oregon, Oregon State University Press.

Steven, J. 2006. Personal communication with Colorado Natural Heritage Program Ecology Team Leader regarding the global rank for mesic tallgrass prairie plant communities.

Western Regional Climate Center. 2006. Pueblo Army Depot, Colorado (056763): 1961-1990 monthly climate summary. [website.] Available at: http://www.wrcc.dri.edu/cgi-bin/cliNORMtM.pl?copued.

Western Regional Climate Center. 2006b. Pueblo WSO AP, Colorado (056740): Period of record - monthly climate summary. [website.] Available at: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?copued

Wyoming Natural Diversity Database. 2006. Natural Diversity Database at the University of Wyoming, Laramie, WY.

Appendix 1: Colorado Noxious Weed List

Noxious Weed Species in Colorado 2006

Plants

Code	Common Name	Scientific Name	List
ABTH	Velvetleaf	*Abutilon theophrasti*	C
AECY	Jointed goatgrass	*Aegilops cylindrica*	C
ALPS3	Camelthorn	*Alhagi pseudalhagi*	A
ANCR2	Spurred anoda	*Anoda cristata*	B
ANAR6	Scentless (Corn) chamomile	*Anthemis arvensis*	B
ANCO2	Mayweed chamomile	*Anthemis cotula*	B
ARMI2	Common burdock	*Arctium minus*	C
ARAB3	Absinth wormwood	*Artemisia absinthium*	B
BRTE	Downy brome (=Cheatgrass)	*Bromus tectorum*	C
CADR	Hoary cress	*Cardaria draba*	B
CAAC	Plumeless thistle	*Carduus acanthoides*	B
CANU4	Musk thistle	*Carduus nutans*	B
CACA19	Wild caraway	*Carum carvi*	B
CEDI3	Diffuse knapweed	*Centaurea diffusa*	B
CEMA4	Spotted knapweed	*Centaurea maculosa*	B
CEPR2	Meadow knapweed	*Centaurea pratensis*	A
CERE6	Russian knapweed	*Centaurea repens*	B
CESO3	Yellow starthistle	*Centaurea solstitialis*	A
CEVI	Squarrose knapweed	*Centaurea virgata*	A
CHJU	Rush skeletonweed	*Chondrilla juncea*	A
CHLE80	Oxeye daisy	*Chrysanthemum leucanthemum*	B
CIIN	Chicory	*Cichorium intybus*	C
CIAR4	Canada thistle	*Cirsium arvense*	B
CIVU	Bull thistle	*Cirsium vulgare*	B
CLOR	Chinese clematis	*Clematis orientalis*	B
COMA2	Poison hemlock	*Conium maculatum*	C
COAR4	Field bindweed	*Convolvulus arvensis*	C
CRVU2	Common crupina	*Crupina vulgaris*	A
CYOF	Houndstongue	*Cynoglossum officinale*	B
CYES	Yellow nutsedge	*Cyperus esculentus*	B
DIFU2	Common teasel	*Dipsacus fullonum*	B
	Cutleaf teasel	*Dipsacus laciniatus*	B
ELAN	Russian-olive	*Elaeagnus angustifolia*	B
ELRE3	Quackgrass	*Elytrigia repens*	B
ERCI6	Redstem filaree	*Erodium cicutarium*	B
EUCY2	Cypress spurge	*Euphorbia cyparissias*	A
EUES	Leafy spurge	*Euphorbia esula*	B
EUMY2	Myrtle spurge	*Euphorbia myrsinites*	A
HAGL	Halogeton	*Halogeton glomeratus*	C
HEMA3	Dame's rocket	*Hesperis matronalis*	B
HITR	Venice mallow	*Hibiscus trionum*	B
HIAU	Orange hawkweed	*Hieracium aurantiacum*	A
HYDRI	Hydrilla	*Hydrilla hydrilla (verticillata)*	A
HYNI	Black henbane	*Hyoscyamus niger*	B

HYPE	Common St. Johnswort	*Hypericum perforatum*	C
ISTI	Dyer's woad	*Isatis tinctoria*	A
LELA2	Perennial pepperweed	*Lepidium latifolium*	B
LECU	Sericea lespedeza	*Lespedeza cuneata*	A
LIDA	Dalmatian toadflax-broadleaf	*Linaria dalmatica*	B
LIGE	Dalmatian toadflax-narrowleaf	*Linaria genistifolia*	B
LIVU2	Yellow toadflax	*Linaria vulgaris*	B
LYSA2	Purple loosestrife	*Lythrum salicaria*	A
	Scentless chamomile	*Matricaria perforata*	B
MYSP2	Eurasian watermilfoil	*Myriophyllum spicatum*	B
ONAC	Scotch thistle	*Onopordum acanthium*	B
ONTA	Bull cotton thistle	*Onopordum tauricum*	B
PAMI2	Wild proso millet	*Panicum miliaceum*	C
PEHA	African rue	*Peganum harmala*	A
PORE5	Sulfur cinquefoil	*Potentilla recta*	B
SAAE	Mediterranean sage	*Salvia aethiopis*	A
SAMO5	Giant salvinia	*Salvinia molesta*	A
SAOF4	Bouncingbet	*Saponaria officinalis*	B
SEJA	Tansy ragwort	*Senecio jacobaea*	A
SOAR2	Perennial sowthistle	*Sonchus arvensis*	C
SOHA	Johnsongrass	*Sorghum halepense*	C
TACA8	Medusahead rye	*Taeniatherum caput-medusae*	A
TAPA4	Tamarisk – small flower	*Tamarix parviflora*	B
TARA	Saltcedar	*Tamarix ramosissima, T. chinensis*	B
TAVU	Common tansy	*Tanacetum vulgare*	B
TRTE	Puncturevine	*Tribulus terrestris*	C
VEBL	Moth mullein	*Verbascum blattaria*	B
VETH	Common mullein	*Verbascum thapsus*	C

From: State of Colorado Department of Agriculture. For definitions of A, B, and C list species see Table 2.

Appendix 2: Wyoming Noxious Weed List

Wyoming Department of Agriculture 2003 Designated Noxious Weeds and Prohibited Noxious Weeds.

Plants Code	Common Name	Scientific Name
CERE6	Russian knapweed	*Centaurea repens* L.
FRDI3	Skeletonleaf bursage	*Franseria discolor* Nutt.
ARMI2	Common burdock	*Arctium minus* Bernh.
CADR	Hoary cress, Whitetop	*Cardaria draba* (L.) Desv.
CAPU6	Hoary cress, Whitetop	*Cardaria pubescens* (C.A. Mey.) Jarmolenko
CAAC	Plumeless thistle	*Carduus acanthoides* L.
CANU4	Musk thistle	*Carduus nutans* L.
CEDI3	Diffuse knapweed	*Centaurea diffusa* Lam.
CEMA4	Spotted knapweed	*Centaurea maculosa auct. non* Lam. [misapplied]
CIAR4	Canada thistle	*Cirsium arvense* (L.) Scop.
COAR4	Field bindweed	*Convolvulus arvensis* L.
CYOF	Houndstongue	*Cynoglossum officinale* L.
AGRE2	Quackgrass	*Agropyron repens* (L.) Beauv.
EUES	Leafy spurge	*Euphorbia esula* L.
HYPE	Common St. Johnswort	*Hypericum perforatum* L.
ISTI	Dyers woad	*Isatis tinctoria* L.
LELA2	Perennial pepperweed	*Lepidium latifolium* L.
CHLE80	Ox-eye daisy	*Chrysanthemum leucanthemum* L.
LIDA	Dalmatian toadflax	*Linaria dalmatica* (L.) P. Mill.
LIVU2	Yellow toadflax	*Linaria vulgaris* P. Mill.
LYSA2	Purple loosestrife	*Lythrum salicaria* L.
ONAC	Scotch thistle	*Onopordum acanthium* L.
SOAR2	Perennial sowthistle	*Sonchus arvensis* L.
TAMAR2	Saltcedar	*Tamarix* spp. L.
TAVU	Common tansy	*Tanacetum vulgare* L.
ELAN	Russian olive	*Elaeagnus angustifolia* L.

From: USDA Plants Database and http://www.wyoweed.org/

Appendix 3: List of relevant county weed contacts, priority weed lists, and services provided

Arapahoe County

County Weed Supervisor: Russell Johnson
Address: 10730 E. Briarwood Avenue, Suite 100
Centennial, CO 80112
Phone Number: 720-874-6713
Fax Number: 303-798-6054
Email Address: rjohnson@co.arapahoe.co.us

Arapahoe County Designated Noxious Weed list:

Myrtle spurge (*Euphorbia myrsinites*) (A)
Russian knapweed (*Centaurea repens*) (A)
Spotted knapweed (*Centaurea maculosa*) (A)
Purple loosestrife (*Lythrum salicaria*) (A)
Dalmatian toadflax (*Linaria dalmatica*) (A)
Yellow toadflax (*Linaria vulgaris*) (A)
Saltcedar (*Tamarix ramosissima and Tamarix chinensis*) (A)
Common teasel (*Dipsacus fullonum*) (B)
Leafy spurge (*Euphorbia esula*) (B)
Diffuse knapweed (*Centaurea diffusa*) (B)
Musk thistle (*Carduus nutans*) (B)
Canada thistle (*Cirsium arvense*) (B)
Russian-olive (*Elaeagnus angustifolia*) (B)
Scotch thistle (*Onopordum acanthium*) (B)
Hoary cress (*Cardaria draba*) (B)
Field bindweed (*Convolvulus arvensis*) (C)
Downy brome = Cheatgrass (*Bromus tectorum*) (C)

El Paso County

County Weed Supervisor: Mark Johnston
Address: 2880 International Circle, Suite 100
Colorado Springs, CO 80910
Phone Number: 719-520-7654
Fax Number: 719-520-7816
Email Address: markjohnston@elpasoco.com
Website Address: www.elpasoco.com/ForNoxWd

El Paso County Noxious Weed List

Canada thistle	Leafy spurge
Knapweed, diffuse	Musk thistle
Knapweed, Russian	Purple loosestrife
Knapweed, spotted	Toadflax, yellow

Services Offered by County:

- Site visits
- Technical consultation and advice
- Association meeting presentations

Fremont County

County Weed Supervisor: J.R. Phillips
Address: 615 Macon Avenue
Canon City, CO 81212
Phone Number: 719-276-7317
Fax Number: *none*
Email Address: *jphil@fremontco.com*
Website Address: *none available*

Fremont County Noxious Weed List

Canada thistle	Knapweed, spotted
Hoary cress (Whitetop)	Leafy spurge
Houndstongue	Musk thistle
Knapweed, diffuse	Toadflax, Dalmatian
Knapweed, Russian	Toadflax, yellow

Services Offered by County:

- Site visits
- Technical consultation and advice
- On-site control services
- 50% cost-share for control of noxious weeds on county list

Las Animas County

County Weed Supervisor: Robert Lucero
Address: 200 E. First, Room 104
Trinidad, CO 81082
Phone Number: 719-846-4486 ext. 1
Fax Number: 719-846-7160
Email Address: lasanimascountyplanning@sensonics.org
Website Address: *none available*

Las Animas County Noxious Weed List

Knapweed, diffuse	Musk thistle
Knapweed, Russian	Scotch thistle
Knapweed, spotted	Toadflax, yellow
Leafy spurge	

Services Offered by County:

- Technical consultation and advice - CSU extension office
- Sprayer available

Pueblo County

County Weed Supervisor: Elizabeth Campbell
Address: Pueblo County Department of Public Works
33601 United Avenue
Pueblo, CO 81001-4896
Phone Number: 719-583-4629
Fax Number: 719-583-4944

Email Address: campbell@co.pueblo.co.us
Website Address: *none available*

Pueblo County Noxious Weed List

Canada thistle Field bindweed Hoary cress (Whitetop) Jointed goatgrass Knapweed, diffuse Knapweed, Russian Knapweed, spotted Kochia	Leafy spurge Musk thistle Russian thistle, slender Russian thistle, prickly Tamarisk (Saltcedar) Toadflax, yellow Yellow starthistle

Services Offered by County:

- Site visits
- Technical consultation and advice
- Noxious weed ordinance information and administration
- County-owned property management
- Weed mapping
- Occasional grant-funded programs for management of designated weeds

Laramie County, Wyoming

County Weed Supervisor: Stan McNamee
Address: Laramie County Weed and Pest Control District
P.O. Box 899
Pine Bluffs, WY 82082
Phone Number: 307-245-3213
Fax Number: *none available*
Email Address: larcoweed@rtconnectnet
Website Address: *none available*

Declared List of Weeds 2006:

Puncturevine (*Tribulus terrestris*)
Common mullein (*Verbascum thapsus*)
Vipers bugloss (*Echium vulgare* L.)

Appendix 4: Natural Heritage Conservation Ranking System

The concept of setting priorities for gathering information and conducting surveys is key to the functioning of Natural Heritage Programs. The number of possible facts and observations that can be gathered about the natural world is essentially limitless. The financial and human resources available to gather such information are not. Because biological surveys tend to be under-funded, there is a premium on devising systems that are both effective in providing information that meets users' needs and efficient in gathering that information. The cornerstone of Natural Heritage surveys is the use of a ranking system to achieve these twin objectives of effectiveness and efficiency.

Ranking species and ecological communities according to their imperilment status provides guidance for where Natural Heritage Programs focus their information-gathering activities. For species deemed secure, only general information is maintained by Natural Heritage Programs. Fortunately, the more common and secure species constitute the majority of most groups of organisms. On the other hand, for those species that are by their nature rare, more detailed information is needed. Because of these species' rarity, gathering comprehensive and detailed population data can be less daunting than gathering similarly comprehensive information on more abundant species.

To determine the status of species within Colorado, CNHP gathers information on plants, animals, and plant communities. Each of these elements of natural diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (for example, 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences (in other words, the number of known distinct localities or populations). This factor is weighted more heavily than other factors because an element found in one place is more imperiled than something found in twenty-one places. Also of importance are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State-rank or S-rank) and the element's imperilment over its entire range (its Global-rank or G-rank). Taken together, these two ranks indicate the degree of imperilment of an element. For example, the lynx, which is thought to be secure in northern North America but is known from less than five current locations in Colorado, is ranked G5 S1 (globally-secure, but critically imperiled in this state). The Rocky Mountain Columbine, which is known only in Colorado from about 30 locations, is ranked a G3 S3 (vulnerable both in the state and globally, since it only occurs in Colorado and then in small numbers). Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1 S1 (critically imperiled both in the state and globally, because it exists in a single location). CNHP actively collects, maps, and electronically processes specific occurrence information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness, and endemism (specificity of habitat requirements), contribute to the conservation priority of each species. Certain species are "watchlisted," meaning that specific occurrence data are

collected and periodically analyzed to determine whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in the table below.

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in the table below, ranks followed by a "B," for example S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N," for example S4N, refer to non-breeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Definition of Natural Heritage Conservation Status Ranks (G and S ranks)

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences, or 3,000 to 10,000 individuals).
G/S4	Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/SX	Presumed extinct globally, or extirpated within the state.
G#?	Indicates uncertainty about an assigned global rank.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but usually not verified for an extended period of time.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used.
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SA	Accidental in the state.
SR	Reported to occur in the state but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Where two numbers appear in a state or global rank (for example, S2S3), the actual rank of the element is uncertain, but falls within the stated range.

Summary of NatureServe's Invasive Species Assessment Protocol (I ranks)
(Morse et al. 2004, NatureServe 2006)

I. Ecological Impact (5 questions; 50% of I-Rank Score)

1. Impact on Ecosystem Processes and System-Wide Parameters (33 points)
2. Impact on Ecological Community Structure (18 points)
3. Impact on Ecological Community Composition (18 points)
4. Impact on Individual Native Plant or Animal Species (9 points)
5. Conservation Significance of the Communities and Native Species Threatened (24 points)

II. Current Distribution and Abundance (4 questions; 25% of I-Rank Score)

6. Current Range Size in Region (15 points)
7. Proportion of Current Range Where Species Is Negatively Impacting Biodiversity (15 points)
8. Proportion of Region's Biogeographic Units Invaded (3 points)
9. Diversity of Habitats or Ecological Systems Invaded in Region (3 points)

III. Trend in Distribution and Abundance (7 questions; 15% of I-Rank Score)

10. Current Trend in Total Range Within Region (18 points)
11. Proportion of Potential Range Currently Occupied (3 points)
12. Long-Distance Dispersal Potential Within Region (9 points)
13. Local Range Expansion or Change in Abundance (18 points)
14. Inherent Ability to Invade Conservation Areas and Other Native Species Habitats (6 points)
15. Similar Habitats Invaded Elsewhere (9 points)
16. Reproductive Characteristics (9 points)

IV. Management Difficulty (4 questions; 10% of I-Rank Score)

17. General Management Difficulty (18 points)

18. Minimum Time Commitment (15 points)

19. Impacts of Management on Native Species (15 points)

20. Accessibility of Invaded Areas (3 points)

For each question, assessors may select one of four defined answers (A-D) or specify Unknown (U). These answers are used to calculate subranks for each of the sections and an overall Invasive Species Impact Rank ("I-Rank") for the species.

I-Rank Values

I-Rank values range from High to Insignificant as follows:

High:	Species represents a severe threat to native species and ecological communities
Medium:	Species represents moderate threat to native species and ecological communities
Low:	Species represents a significant but relatively low threat to native species and ecological communities
Insignificant:	Species represents an insignificant threat to native species and ecological communities

Generally speaking, factors which can push a species' I-Rank upward (towards High) are the ability to change ecosystem processes; ability to invade relatively undisturbed ecological communities; ability to cause substantial impacts on rare or vulnerable species or ecological communities, or high-quality examples of more common communities; wide distribution and general abundance where present; ability to disperse to new areas readily; and difficulty of control. Conversely, species with minimal impacts on ecosystem processes, native species, and ecological communities will generally be assigned an I-Rank of Low or Insignificant. Other factors that can push a species' I-Rank downward are lack of potential to spread beyond

Appendix 5: List of other non-natives that have been documented at each military installation.

Because most installations do not have detailed lists of plants occurring on the installation, the absence of a check for a species at a particular installation does not necessarily mean that it is not present. Shaded species are those documented at F.E. Warren that are on Colorado's noxious weed list, but not Wyoming's list.

Common Name:	Scientific Name:	Buckley	Cheyenne	F.E. Warren	Fort Carson	Peterson	PCMS	PCD	Schriever	USAFA
Crested wheatgrass	*Agropyron cristatum*	X		X			X			X
Redtop	*Agrostis gigantea*									X
Redtop Bentgrass	*Agrostis stolonifera*			X			X	X		
Tree of heaven	*Ailanthus altissima*									X
Creeping meadow foxtail	*Alopecurus arundinaceus*			X						
Desert madwort	*Alyssum desertorum*							X		
Alyssum	*Alyssum simplex (=Alyssum minus)*	X								X
Redroot pigweed	*Amaranthus retroflexus*							X		X
Asparagus	*Asparagus officinalis*						X	X		X
Cicer milkvetch	*Astragalus cicer*			X						
Wild oat	*Avena fatua*						X			
Garden yellowrocket	*Barbarea vulgaris*									X
Hoary alyssum	*Berteroa incana*									X
Nodding beggartick	*Bidens cernua*			X						
Beggar's tick	*Bidens sp.*					X				
Smooth brome	*Bromus inermis*	X		X	X					X
Japanese Brome	*Bromus japonicus*			X	X		X	X		X
Bald brome	*Bromus racemosus (=Bromus commutatus)*			X						
Cheatgrass	*Bromus tectorum*	--	--	X	--	--	--	--	--	--
Hedge false bindweed	*Calystegia sepium*									X
False flax	*Camelina microcarpa*	X		X			X			X
False flax	*Camelina spp.*							X		
Marijuana	*Cannabis sativa*									X
Shepherd's purse	*Capsella bursa-pastoris*									X
Siberian peashrub	*Caragana arborescens*									X
Lenspod whitetop	*Cardaria chalepensis*									X
Whitetop	*Cardaria pubescens*	X								
Lambsquarters, Goosefoot	*Chenopodium album*			X			X	X		
Crossflower	*Chorispora tenella*									X
Hare's ear mustard	*Conringia orientalis*									X
Marsh elder	*Cyclachaena xanthifolia (=Iva xanthifolia)*							X		
Orchard grass	*Dactylis glomerata*	X					X			
Tansy mustard	*Descurainia sophia*	X					X			X
Smooth crabgrass	*Digitaria ischaemum*									X
Large crabgrass	*Digitaria sanguinalis*							X		
Barnyard Grass	*Echinochloa crus-galli*						X	X		X
Russian Olive	*Eleagnus angustifolia*	--	--	X	--	--	--	--	--	--
Tall wheatgrass	*Elytrigia elongata*			X						

Intermediate wheatgrass	*Elytrigia intermedia*			X						X
Mediterranean lovegrass	*Eragrostis barrelieri*			X						
Stinkgrass	*Eragrostis cilianensis*							X		
Toothed spurge	*Euphorbia dentata* var. *dentata* *(=Poinsettia dentata)*									X
Tall fescue	*Festuca arundinacea*			X						
Sheep fescue	*Festuca ovina*									X
Green ash	*Fraxinus pennsylvanica*									X
Baby's breath	*Gypsophila paniculata*			X		X				
Kochia	*Kochia scoparia (=Bassia scoparia)*	X	X	X	X	X	X	X	X	X
Prickly lettuce	*Lactuca serriola*			X			X	X		X
Henbit deadnettle	*Lamium amplexicaule*									X
Field pepperweed	*Lepidium campestre* *(=Neolepia campestris)*									X
Clasping pepperweed	*Lepidium perfoliatum*								X	
Blue flax	*Linum usitatissimum*							X		
Sweet alyssum	*Lobularia maritima*									X
Morrow's honeysuckle	*Lonicera morrowii*									X
Common mallow	*Malva neglecta*			X						X
Common Hoarhound	*Marrubium vulgare*						X			
Black medic	*Medicago lupulina*	X		X						X
Alfalfa	*Medicago sativa*	X		X				X		X
White Sweetclover	*Melilotus alba*			X			X	X		X
Yellow sweet clover	*Melilotus officinale*	X		X			X	X	X	X
Spearmint	*Mentha spicata*									X
Watercress	*Nasturtium officinale*									X
Catnip	*Nepeta cataria*			X						X
Virginia creeper	*Parthenocissus quinquefolia*							X		X
Pale smartweed	*Persicaria lapathafolia*							X		
Timothy	*Phleum pratense*			X			X	X		X
Common plantain	*Plantago major*			X						X
Annual bluegrass	*Poa annua*									X
Kentucky bluegrass	*Poa pratensis*	X		X			X	X		X
Oval-leaf knotweed	*Polygonum arenastrum*									X
Prostrate knotweed	*Polygonum aviculare*							X		
Black bindweed	*Polygonum convolvulus*			X						X
Rabbitfoot Grass	*Polypogon monspeliensis*			X			X	X		
Purslane	*Portulaca oleracea*									X
Common sheep sorrel	*Rumex acetosella*									X
Curly dock	*Rumex crispus*	X		X			X	X		X
Narrowleaf Dock	*Rumex stenophyllus*						X			
Crack willow	*Salix fragilis*									X
Slender Russian thistle	*Salsola collina*			X				X		X
Prickley Russian thistle	*Salsola iberica*			X			X	X		
Russian thistle	*Salsola kali*	X	X						X	
Russian thistle	*Salsola sp.*				X	X				
Lanceleaf sage	*Salvia reflexa*	X								
Meadow fescue	*Schedonorus pratensis* *(=Festuca pratensis)*									X
Rye grass	*Secale cereale*	X								
Common groundsel	*Senecio vulgaris*									X
Yellow foxtail	*Setaria pumila* ssp. *pumila* *(=Setaria glauca)*									X
Green bristlegrass	*Setaria viridis*									X

Red catchfly	*Silene dioica (=Melandrium dioicum)*									X
Jim Hill mustard	*Sisymbrium altissimum*	X		X				X	X	X
Small tumbleweed mustard	*Sisymbrium loeselii*									X
Hedgemustard	*Sisymbrium officinale*							X		
Black nightshade	*Solanum nigrum*						X			
Hoe nightshade	*Solanum physalifolium*							X		X
Spiny sowthistle	*Sonchus asper*							X		
Common chickweed	*Stellaria media ssp. media (=Alsine media)*									X
Dandelion	*Taraxacum officinale*	X		X			X		X	X
Pennycress	*Thlaspi arvense*	X		X					X	X
Salsify	*Tragopogon dubius*	X		X			X	X	X	X
Red clover	*Trifolium pratense*			X						X
White clover	*Trifolium repens*									X
Common wheat	*Triticum aestivum*									X
Siberian elm	*Ulmus pumila*									X
Cowcockle	*Vaccaria pyramidata*							X		
Common mullein	*Verbascum thapsus*	X		X	X		X	X		X
Prostrate vervain	*Verbena bracteata*	X						X		X
Twolobe speedwell	*Veronica biloba (=Pocilla biloba)*									X
English violet	*Viola odorata*							X		
Cocklebur	*Xanthium strumarium*						X	X		X

Appendix 6: Sources of information about weed species

Bureau of Land Management: The Weed Hall of Shame
http://www.blm.gov/education/weeds/hall_of_shame.html

Colorado Environmental Pesticide Education Program (CEPEP) – Noxious weed information
http://www.colostate.edu/Depts/SoilCrop/extension/CEPEP/noxious.htm

Colorado Weed Management Association
http://www.cwma.org/

Invasive and Exotic species – weeds
http://www.invasive.org/weeds.cfm

National Agricultural Pest Information System (NAPIS) - Pest Tracker
http://ceris.purdue.edu/napis/index.html

National Biological Information Infrastructure (NBII) – invasive species
http://invasivespecies.nbii.gov/

NatureServe – Invasive Species
http://www.natureserve.org/consIssues/invasivespecies.jsp

Plant Conservation Alliance (pca) – Weeds Gone Wild
http://www.nps.gov/plants/alien/index.htm

Southwest Colorado Wildflowers, Ferns and Trees – Noxious weeds
http://www.swcoloradowildflowers.com/noxious%20weeds.htm

State of Colorado Department of Agriculture- weeds program
http://www.ag.state.co.us/csd/weeds/weedpublications/noxweeds.html

The Nature Conservancy (TNC) - Global Invasive Species Initiative
http://tncweeds.ucdavis.edu/

University of Wyoming – weed identification site
http://www.uwyo.edu/CES/WYOWEED/wyoweed.htm

USDA, National Agricultural Library, Plants
http://www.invasivespeciesinfo.gov/plants/main.shtml

USDA Plants database
http://plants.usda.gov/

US Department of Transportation, Federal Highway Administration – Roadside Vegetation Management
http://www.fhwa.dot.gov/environment/vegmgt/index.htm

USGS, The National Institute of Invasive Species Science (NIISS)
http://www.niiss.org/cwis438/websites/niiss/Home.php

Weeds of the West
http://www.uwyo.edu/CES/WYOWEED/profession/wedwest.htm

Wyoming Pest Detection Program
http://uwadmnweb.uwyo.edu/capsweb/PEST_INFO_DIRECTORIES/pest_info_plant_pests.htm

Noxious and Nuisance Plant Management Information System (npmi) - US Army Corp of Engineers
http://el.erdc.usace.army.mil/pmis/

Appendix 7: Sources of weed control information

Colorado Environmental Pesticide Education Program (CEPEP) – Noxious weed information
http://www.colostate.edu/Depts/SoilCrop/extension/CEPEP/noxious.htm

Colorado Natural areas Program (CNAP): Creating an Integrated Weed Management Plan
http://parks.state.co.us/cnap/IWM_handbook/IWM_index.htm

Colorado Weed Management Association
http://www.cwma.org/

Cooperative Agricultural Pest Survey (CAPS) – Program Guidebook
http://www.nappfast.org/caps/CAPSGuidebookComplete.pdf

National Biological Information Infrastructure (nbii) – invasive species
http://invasivespecies.nbii.gov/

State of Colorado Department of Agriculture- weeds program
http://www.ag.state.co.us/csd/weeds/weedpublications/noxweeds.html

The Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW)
http://www.fws.gov/ficmnew/index.html

The Nature Conservancy (TNC) - Global Invasive Species Initiative
http://tncweeds.ucdavis.edu/

USDA, National Agricultural Library, Plants
http://www.invasivespeciesinfo.gov/plants/main.shtml

USGS, The National Institute of Invasive Species Science (NIISS)
http://www.niiss.org/cwis438/websites/niiss/Home.php

Appendix 8: Sources of weed monitoring information

Invasive and Exotic species – Monitoring changes in Exotic Vegetation
http://www.invasive.org/symposium/sutter.html

National Agricultural Pest Information System (NAPIS) - Pest Tracker
http://ceris.purdue.edu/napis/index.html

NatureServe – Invasive Species http://www.natureserve.org/consIssues/invasivespecies.jsp

State of Colorado Department of Agriculture- weeds program
http://www.ag.state.co.us/csd/weeds/weedpublications/noxweeds.html
http://www.ag.state.co.us/CSD/Weeds/mapping/WeedInventoryBasics.html

The Nature Conservancy (TNC) - Global Invasive Species Initiative
http://tncweeds.ucdavis.edu/

USDA, National Agricultural Library, Plants
http://www.invasivespeciesinfo.gov/plants/main.shtml

USGS, The National Institute of Invasive Species Science (NIISS)
http://www.niiss.org/cwis438/websites/niiss/Home.php

Measuring and Monitoring Plant Populations by Elzinga et al.
http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf

Copies available from:
Bureau of Land Management
National Business Center
BC-650B
P.O. Box 25047
Denver, Colorado 80225-0047

Appendix 9: Rare species and ecological system descriptions

For additional information see NatureServe 2006.

PLANTS

Ptilagrostis porteri (Porter's feathergrass)

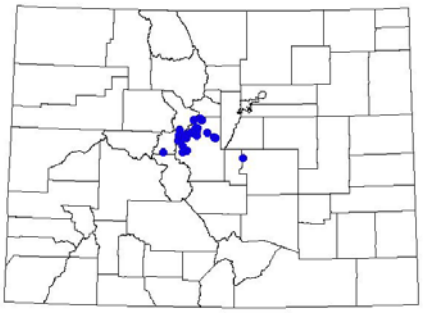
Taxonomy
Class: Monocotyledoneae
Order: Cyperales
Family: Poaceae
Genus: *Ptilagrostis*

Photo copyright © CNHP

Taxonomic Comments: This taxon is still considered by W.A. Weber (University of Colorado) to be a distinct species (*Ptilagrostis porteri*), but was classified by Kartesz (1994 checklist), following Barkworth (1983), as the subspecies *Ptilagrostis mongholica* ssp. *porteri*. *Ptilagrostis mongholica* is otherwise an Asiatic species.

CNHP Ranking: G2 S2

State/Federal Status: Forest Service and BLM Sensitive.



Colorado Distribution

Phenology: Fruit maturing from mid-August to early September.

Habitat Comments: Hummocks in fens and willow carrs, at elevations between 9,200 and 12,000 ft (2,776 to 3,701 m)

Global Range: Known only from central Colorado (El Paso, Lake, Park, and Summit counties).

State Range: See above.

Distribution/Abundance: Twenty-seven occurrences have been documented in Colorado for this species, but many of these have likely been extirpated.

Known Threats and Management Issues: Peat mining, wetland ditching, and other hydrological alterations to its habitat pose the greatest threat to this species.

[[from El Paso County report 2001]]

Version date: December 2001

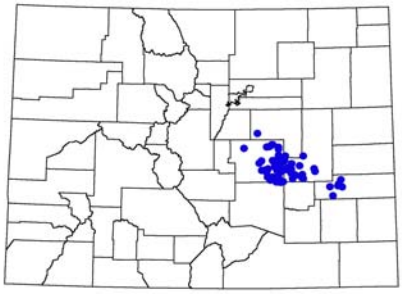
Ambrosia linearis (Plains ambrosia)

Taxonomy
Class: Dicotyledoneae
Order: Asterales
Family: Asteraceae
Genus: *Ambrosia*

Taxonomic Comments: None.

CNHP Ranking: G3 S3

State/Federal Status: Forest Service Sensitive



Photograph copyright © CNHP

Phenology: The inconspicuous flowers appear in early June and continue through August; fruiting continues through September (Spackman *et al*. 1997).

Habitat Comments: Known primarily from clayey soils, but also from sandy soils in seasonally moist habitats in prairies. Frequently encountered in association with intermittent streams and around the margins of intermittent ponds and playas. It is also found along roadsides and ditches. Elevation ranges from 4,300 to 6,700 ft (1,326 to 2,066 m).

Global Range: The plains ambrosia is a restricted in range to the shortgrass prairie of east central Colorado.

State Range: It is known from Elbert, Lincoln, Cheyenne, Kiowa, Crowley, El Paso, and Pueblo counties.

Distribution/Abundance: In natural occurrences, which are limited to playa and dry creek margin habitats, there are an estimated 50,000 to 100,000 individuals at this time. As this species is common on roadsides within its range, additional hundreds of thousands of individuals are presumed to exist.

Known Threats and Management Issues: Development of land for housing and agriculture poses the greatest threat to this species. Playas and creek banks have been subject to significant disturbance and alteration throughout the range of this species, and further reduction of these habitats is ongoing. Many occurrences are eminently threatened by the rapid subdivision of southeastern El Paso County. Rapidly increasing density of humans, livestock, and infrastructure in east central Colorado is resulting in overall reduced quality of habitat for this species.

Version date: December 2001

Aquilegia chrysantha var. *rydbergii* (Golden columbine)

Taxonomy
Class: Dicotyledoneae
Order: Ranunculales
Family: Helleboraceae
Genus: *Aquilegia*

Taxonomic Comments: The Flora of North America Association (1997) questions the distinctiveness of the variety *rydbergii*, saying that material seen displays traits which fall within the normal variation for the species.

CNHP Ranking: G4T1Q S1

State/Federal Status: BLM Sensitive

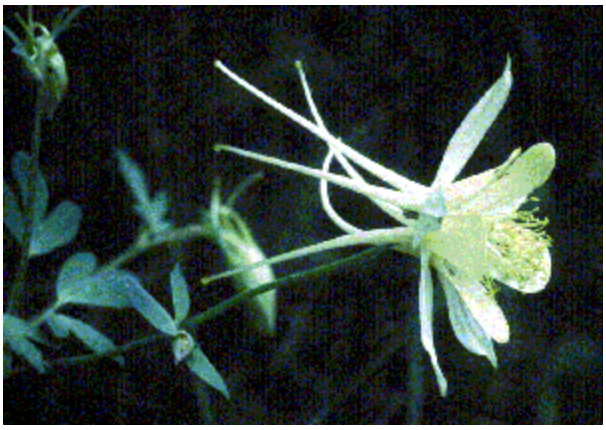
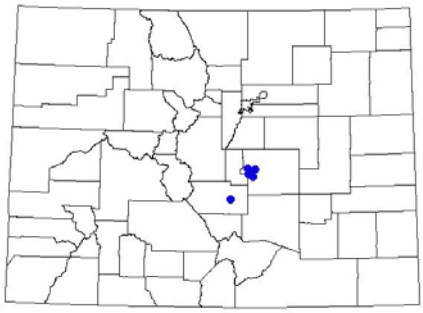


Photo copyright © 1999 by B. Jennings



Colorado Distribution

Phenology: Flowers in June.

Habitat Comments: In mountains especially along streams or in rocky ravines. Elevation range is 5,500 to 6,000 ft (1,696 to 1,850 m).

Global Range: This variety of *A. chrysantha* is known only from Colorado, with eight documented occurrences.

State Range: The type locality for this variety is Canon City, Fremont County. The only other records are from the Colorado Springs area, El Paso County. Recently discovered in Long Canyon near Boulder, however, it is thought to be introduced at this location.

Distribution/Abundance: Of the eight locations documented for this species, only four have been recently revisited and are known to be extant. It has not been seen in Fremont County since 1873. Population estimates at the known occurrences range from 100 to 500 individuals. The known population of this species does not exceed 1,000 plants.

Known Threats and Management Issues: Two occurrences are located on the Pike-San Isabel National Forest. Development, trampling from hikers, erosion, and flower picking threaten the known occurrences.

[[from El Paso County report 2001]]

Version date: December 2001

Gaura neomexicana ssp. *coloradensis* (Colorado Butterfly Plant)

Taxonomy
Class: Dicotyledoneae
Order: Myrtales
Family: Onagraceae
Genus: *Gaura*

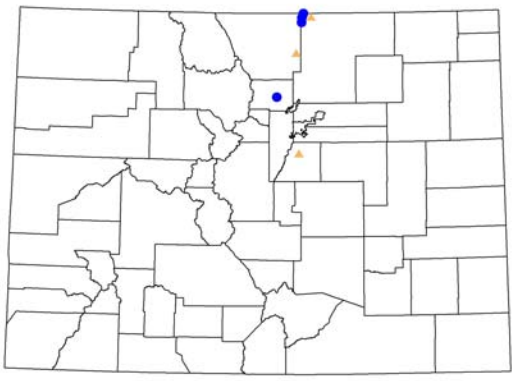
Taxonomic comments: Possibility that it may become recognized at species level.

CNHP Ranking: G3T2 S1

State/Federal Status: Listed as federally threatened

Phenology: Flowering June-September. Fruiting July-October.

photo by G. Doyle



Colorado Distribution
(triangles represent historic occurrences)

Perennial herb with one to several reddish, pubescent stems 50-80 cm tall (Spackman *et al*. 1997).

Habitat Comments: Subirrigated, alluvial soils on level or slightly sloping floodplains and drainage bottoms. Colonies are often found in low depressions or along bends in wide, meandering stream channels, a short distance upslope of the actual channel. Elev. 5000-6400 feet. (Spackman *et al*. 1997, Fertig 2000).

Global Range: Laramie County, Wyoming, western Kimball County, Nebraska, and Weld and Boulder counties in northcentral CO.

State Range: Weld and Boulder counties. Historically, this taxon was also known from Larimer and Douglas counties in CO, but these populations are thought to be extirpated.

Distribution/Abundance: Population fluctuations inherent to biennial taxa. Locally abundant to sparse.

Known Threats and Management Issues: Periodic disturbance events are necessary to maintain suitable habitat, control competing vegetation, and open bare ground for seedling establishment (Fertig 2000). On agricultural lands, herbicide spraying, grazing by cattle and horses, haying and mowing, water development, conversion of rangeland to cultivation, competition from exotic plants, and loss of habitat to urban expansion are also threats.

Fertig, W. 2000. Wyoming Natural Diversity Database state species abstract for *Gaura neomexicana ssp. coloradense*, Colorado butterfly plant, Onagraceae. 6 pp.

Spackman, S., B. Jennings, J. Coles, C. Dawson, M. Minton, A. Kratz, and C. Spurrier. 1997. Colorado Rare Plant Field Guide. Prepared for the Bureau of Land Management, the U.S. Forest Service and the U.S. Fish and Wildlife Service by the Colorado Natural Heritage Program.

Version Date: May 2005
[Larimer County report Doyle et al. 2005]

Heuchera richardsonii (Richardson's alumroot)

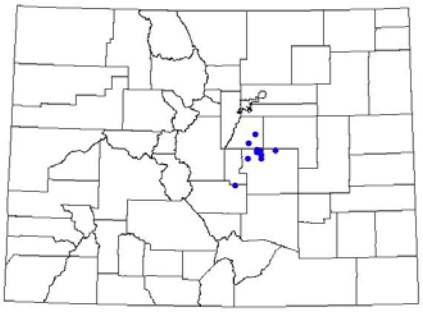
Taxonomy
Class: Dicotyledoneae
Order: Rosales
Family: Saxifragaceae
Genus: *Heuchera*

No Picture Available

Taxonomic Comments: None.

CNHP Ranking: G5 S1

State/Federal Status: None.



Colorado Distribution

Phenology: Flowers June through July.

Habitat Comments: In Colorado, occurs in low elevation Ponderosa pine woods in the Front Range foothills at elevations of 6,000 to 7,500 ft (1,850 to 2,313 m).

Global Range: The plant is present in a wide range through the United States (IL, IN, IA, KS, MI, MN, MO, MT, NE, ND, OK, SD, WI, WY) and Canada.

State Range: Douglas, El Paso, Teller, and Fremont counties.

Distribution/Abundance: There are 10 sites of *H. richardsonii* recorded in the state with six of the sites occurring in El Paso County. Many sites are historical records and may have been extirpated by development.

Known Threats and Management Issues: At many of the occurrences, weeds are present with yellow toadflax, (*Linaria vulgaris*) as the most invasive. Also, residential encroachment is a threat at many of the sites.

[[from El Paso County report 2001]]

Version date: December 2001

Liatris ligulistylis (Strap-style Gayfeather)

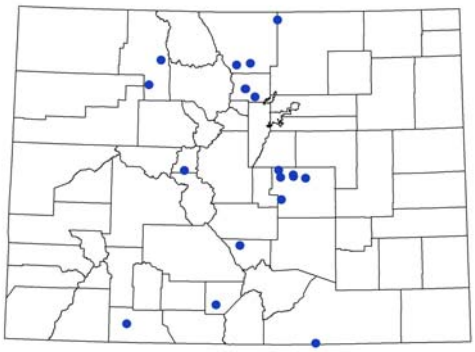
Taxonomy
Class: Dicotyledoneae
Order: Asterales
Family: Asteraceae
Genus: *Liatris*

photo by G. Doyle

Taxonomic comments: None

CNHP Ranking: G5? S1S2

State/Federal Status: None.



Colorado Distribution

Phenology: Flowers July to September.

Habitat Comments: Open, often moist sites. At base of slopes or in the low grasslands bordering wetlands.

Global Range: U.S: Colorado, Connecticut, Illinois, Iowa, Minnesota, Montana, New Mexico, North Dakota, South Dakota, Wisconsin, Wyoming. Canada: Alberta, Manitoba, Saskatchewan.

State Range: Widely scattered in wetlands.

Distribution/Abundance: Globally common. Rare in Colorado.

Known Threats and Management Issues: Hydrologic alteration of wetlands, grazing. Sheep will consume round-headed blazing star but it seems to be mostly avoided by cattle and so persists under moderate grazing pressure in most pastures (Kantrud 1995).

Kantrud, H.A. 1995. Native Wildflowers of the North Dakota Grasslands. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/plants/wildflwr/wildflwr.htm (Version 06JUL2000).

Version Date: May 2005
[Larimer County report Doyle et al. 2005]

Potentilla ambigens (Southern Rocky Mountain Cinquefoil)

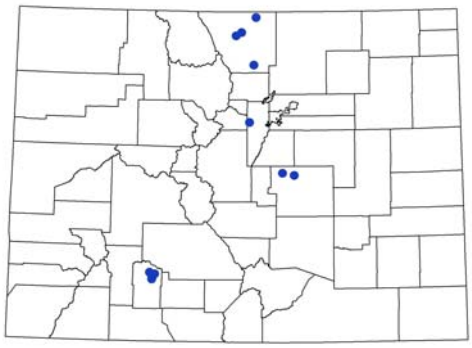
Taxonomy
Class: Dicotyledoneae
Order: Rosales
Family: Rosaceae
Genus: *Potentilla*

Taxonomic comments: Resembles a gigantic *P. hippiana* var *hippiana.*

CNHP Ranking: G3 S1S2

State/Federal Status: None.

photo by R. Rondeau



Colorado Distribution

Phenology: Flowers in mid- to late July, fruits in August (Anderson 2006).

Large perennial herbs.

Habitat Comments: The sparse information available about this species indicates that it occurs in dry open shrublands or grasslands at middle elevations in the mountains. At least one occurrence grows on gravelly soil, and another occurs on a roadside. May occur in montane woods, although most Colorado populations are on grassy or colluvium slopes (Rondeau pers. comm. 1999).

Global Range: This species occurs very disjunctly throughout three states. It appears most common in New Mexico, although it is not well documented in collections at the University of New Mexico herbarium. In Colorado, the species has a very patchy distribution, and it has not been recorded in Wyoming since 1900.

State Range: Very patchy distribution. Largest populations are in Larimer and Mineral counties.

Distribution/Abundance: 13 extant occurrences in Colorado. Sparse to locally abundant.

Known Threats and Management Issues: Threats include off-road vehicle use and other recreation, residential and commercial development, secondary impacts of grazing, road construction and management, hydrologic alteration, and non-native species invasion (Anderson 2006).

Anderson, D.G. 2006. *Potentilla ambigens* Greene (silky leaf cinquefoil): a technical conservation assessment. [Online]. USDA Forest Service Rocky Mountain Region. Available http://www.fs.fed.us/r2/projects/scp/assessments/potentillaambigens.pdf

Version Date: May 2005
[Larimer County report, Doyle et al. 2005]

BIRDS

Bald Eagle *(Haliaeetus leucocephalus)*

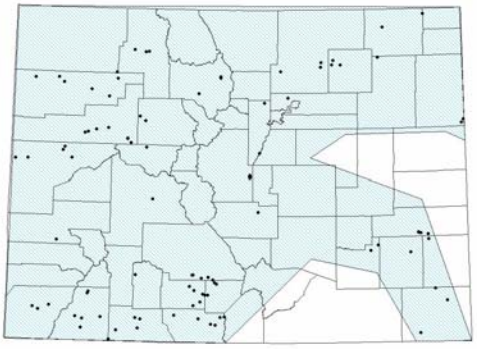
Taxonomy:
Class: Aves
Order: Falconiformes
Family: Accipitridae
Genus: *Haliaeetus*

Taxonomic Comments: none.

CNHP Ranking: G4 S1B,S3N

State/Federal Status: Federally threatened

Habitat Comments: Bald Eagles that nest in Colorado use large, mature cottonwoods or pines, often along rivers, to hold their heavy nests (CBBA 1998). Wintering populations will use major rivers, reservoirs, and prairie dog towns (MBW).



Distribution: Bald Eagles live throughout North America - from Alaska to Newfoundland, and from the tip of Florida to southern California, and nest across Colorado (CBBA 1998).

Important Life History Characteristics: Bald Eagles begin nesting in late February, and can often be observed feeding their young into late June (CBBA 1998).

Known Threats and Management Issues: Continued threats to this species include high pesticide use, poisoning, poaching, and loss of nesting habitat due to the enduring popularity of waterfront development (CNHP 1997).

Buteo regalis
Ferruginous Hawk

Taxonomy:
Class: Aves
Order: Falconiformes
Family: Accipitridae
Genus: *Buteo*

Taxonomic Comments: There are no subspecies documented for this species.

CNHP Rank: G4S3B, S4N

Distribution: Global range: This species winters in the southern United States and the northern interior parts of Mexico (Bechard and Schmutz 1995). State range: About 1,200 birds winter in Colorado (Johnsgard 1990), comprising about twenty percent of the total winter population in the United States (Andrews and Righter 1992). Fairly common winter resident but a rare to uncommon summer resident on eastern plains (Andrews and Righter 1992).

Known Locations in Study Site: A pair was located within the study site at a Colorado Division of Wildlife nesting structure approximating the Gunnison's prairie dog popuulation.

Habitat Comments: Grasslands and shrublands consisting of Indian ricegrass (*Oryzopsis hymenoides*), needle-and-thread grass (*Stipa comata*) with some rabbitbrush (*Chrysothamnus nauseosus*) dominated the habitat where the nest structure was located. The Ferruginous Hawk prefers open grasslands, shrublands and deserts (Bechard and Schmutz 1995). Breeding pairs nest in isolated trees, on rock outcrops, structures such as windmills and power poles, or on the ground. Winter populations concentrate around prairie dog towns (Andrews and Righter 1992).

Known Threats and Management Issues: Local population declines are attributed to the effects of cultivation, grazing, poisoning small mammals, mining and fire in nesting habitats (Bechard and Schmutz 1995). Colorado's breeding population is considered vulnerable (S3B) based on human reduction of the primary winter prey base (prairie dog colonies), small population size, and human encroachment into available habitat (CNHP 1997).

Andrews, R., and R. Righter. 1992. Colorado birds: a reference to their distribution and habitat. Denver Mus. Nat. Hist., Denver. 442 pp.

Bechard, M.J. and J.K. Schmutz. 1995. Ferruginous Hawk (*Buteo regalis*). No. 172 in A. Poole and F. Gill editors. The Birds of North America. The Academy of Natural Sciences, Philadelphia and the American Ornithologist's Union Washington D.C.

Johnsgard, P.A. 1990. Hawks, eagles and falcons of North America. Smithsonian Institute Pres, Washington D.C. xvi + 403 pp.

Charadrius montanus (Mountain Plover)

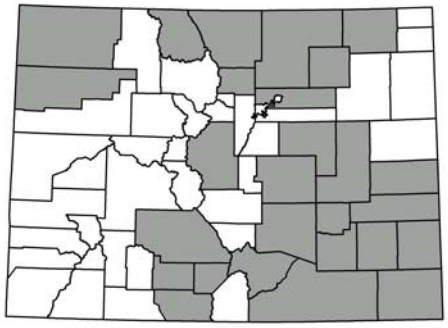
Taxonomy
Class: Aves
Order: Charadriiformes
Family: Charadriidae
Genus: *Charadrius*

Photo by M. B. Wunder

Taxonomic Comments: Formerly known as *Eupoda montana.*

CNHP Ranking: G2 S2B, SZN

State/Federal Status: Forest Service sensitive; BLM sensitive; species of special concern (Colorado) Proposed for listing under the Endangered Species Act by the U.S. Fish and Wildlife Service in 1999, but was withdrawn in 2003 (Dinsmore 2003).



Mountain Plover breeding distribution in Colorado (adapted from Andrews and Righter 1992)

Habitat Comments: Breeding Mountain Plovers occupy open habitats with low-growing vegetation, especially shortgrass prairie characterized by the presence of blue grama grass and buffalo grass (Graul 1975, Graul and Webster 1976, Knopf and Miller 1994). In grasslands where vegetation grows taller than approximately three inches in height, Mountain Plovers use intensively grazed areas (Graul and Webster 1976, Knopf 1996c), prairie dog towns (Knowles *et al.* 1982; Knowles and Knowles 1984, Olson and Edge 1985, Shackford 1991), and fallow or recently plowed agricultural fields (Shackford 1991, Shackford *et al.* 1999). On their wintering grounds in California, Mountain Plovers use plowed or burned agricultural fields and heavily grazed annual grasslands (Knopf and Rupert 1995). In Texas, wintering Mountain Plovers use coastal prairies, alkaline flats, plowed fields, and Bermuda grass fields (Oberholser 1974).

Distribution: Mountain Plovers breed in parts of Montana, Wyoming, Colorado, New Mexico, and in adjacent portions of Utah, Oklahoma, and Texas (Knopf 1996a). An isolated breeding population occurs in the Davis Mountains of western Texas (Knopf 1996a). In late summer, birds form flocks and disperse widely across the western and southern Great Plains before migrating to their wintering range (Knopf 1996a). Mountain Plovers winter in California, southern Arizona, southern Texas, and Mexico (see refs. in Knopf 1996a). In Colorado, the greatest numbers of breeding Mountain Plovers occur in Weld County (Graul and Webster 1976). The breeding range of this species has undergone a dramatic long-term contraction, both in Colorado (Andrews and Righter 1992) and throughout the western Great Plains (Graul and Webster 1976).

Important Life History Characteristics: Mainly a bird of the high plains and semi-desert regions of western North America, the Mountain Plover is one of the few "shorebirds" that lives away from water in arid regions (Terres 1980). Mountain Plovers arrive on their breeding areas in Colorado in late March (Graul 1975, Knopf and Rupert 1996), when males often return to the same territories they occupied the previous year (Graul 1973). Displays of territorial males include a "falling leaf" display (the male rocks back and forth with his wings held in a sharp "V" as he drops to the ground from 15-30 feet in the air), a slow "butterfly flight" (with slow, deep wingbeats) and ritualized scraping of the ground (a courtship display in which the male presses his chest against the ground and scrapes soil with one foot at a time as he cocks his fanned tail), which produces potential nest sites throughout the territory (Graul 1973). After mating occurs and eggs are laid in a rudimentary nest located in a scrape on the ground, some females leave their mates to incubate the clutch while they begin a second clutch with a new male (Graul 1973). When this occurs, the female typically incubates the second clutch (Graul 1973, 1975, 1976). This uncommon form of polygamy, in which a female mates successively with more than one male is called successive (Krebs and Davies 1993) or sequential (Reynolds 1987) polyandry. Mountain Plover nests often are situated very close to dried cow manure piles, perhaps to provide disruptive coloration and thereby reduce the probability of nest predation, or perhaps to help the birds more easily relocate their nests (Graul 1975, Knopf and Miller 1994). An incubating Mountain Plover may fly up into the face of a cow to distract the animal and prevent trampling of the nest; this behavior apparently evolved during the long association between grazing bison and breeding Mountain Plovers (Walker 1955; Graul 1973, 1975; McCaffery *et al.* 1984). Mountain Plovers feed on the ground, consuming insects such as grasshoppers, crickets, beetles, and flies (Baldwin 1971, Knopf 1998). Most activities are restricted to the crepuscular hours to avoid the heat of the day (Graul 1975). Mountain Plovers begin to leave their breeding territories and form flocks shortly after the chicks fledge, which occurs in early July in Colorado (Knopf and Rupert 1996). They arrive on the California wintering areas in September and October (Small 1994, Knopf and Rupert 1995).

Known Threats and Management Issues: Breeding Bird Survey data indicate a decline of two-thirds in the continental population during the period 1966-1993 (Knopf 1996c). Once widely distributed in eastern Colorado (Sclater 1912, Bailey and Niedrach 1965), Mountain Plovers underwent a dramatic range reduction due to loss of habitat as native prairie was converted to cropland (see refs. in Andrews and Righter 1992). Habitat loss to agricultural activities also has severely reduced the species' breeding range outside Colorado (Samson and Knopf 1994). Mountain Plovers no longer breed in the Dakotas or in Kansas, for example, probably because of this factor (Graul and Webster 1976). Additional threats to Mountain Plovers and their habitat include gas, oil, and mineral extraction activities, livestock grazing and spring plowing (the timing and extent), collisions with motor vehicles, and recreational activities (Underwood 1994). Human disturbance at nest sites may cause nest abandonment (Graul 1975, Miller and Knopf 1993). Prior to 1900, Mountain Plovers were an important game bird for market hunters (Grinnell *et al.* 1918, Sandoz 1954).

Andrews, R., and R. Righter. 1992. Colorado birds: a reference to their distribution and habitat. Denver Mus. Nat. Hist., Denver. 442 pp.

Bailey, A. M., and R. J. Niedrach. 1965. Birds of Colorado. Denver, Colo.: Denver Mus. Nat. Hist. 895 pp.

Baldwin, P. H. 1971. Diet of the Mountain Plover at the Pawnee National Grassland, 1970-71. U.S. International Biological Program, Grassland Biome Progr. Rep. No. 134, Fort Collins, Colo.

Dinsmore, S.J. 2003. Mountain Plover (*Charadrius montanus*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/mountainplover.pdf (accessed April 6, 2005).

Graul, W. D. 1973. Adaptive aspects of the Mountain Plover social system. Living Bird 12:69-94.

Graul, W. D. 1975. Breeding biology of the Mountain Plover. Wilson Bull. 87:6-31.

Graul, W. D. 1976. Food fluctuations and multiple clutches in the Mountain Plover. Auk 93:166-167.

Graul, W. D., and L. E. Webster. 1976. Breeding status of the Mountain Plover. Condor 78:265-267.

Grinnell, J., H. C. Bryant, and T. I. Storer. 1918. The game birds of California. Berkeley: Univ. Calif. Press.

Knopf, F. L. 1996a. Mountain Plover (*Charadrius montanus*). In The birds of North America, No. 211 (A. Poole and F. Gill, editors). Philadelphia: Acad. Nat. Sci. and Washington, D.C.: Amer. Ornithologists' Union. 16 pp.

Knopf, F.L. 1996c. Mountain Plover (*Charadrius montanus*). in The Birds of North America, No. 211 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Knopf, F. L. 1998. Foods of Mountain Plovers wintering in California. Condor 100:382-384.

Knopf, F. L., and B. J. Miller. 1994. *Charadrius montanus* - montane, grassland, or bare-ground plover? Auk 111:504-506.

Knopf, F. L., and J. R. Rupert. 1995. Habits and habitats of Mountain Plovers in California. Condor 97:743-751.

Knopf, F. L., and J. R. Rupert. 1996. Reproduction and movements of Mountain Plovers breeding in Colorado. Wilson Bull. 108:28-35.

Knowles, C. J., and P. R. Knowles. 1984. Additional records of Mountain Plovers using prairie dog towns in Montana. Prairie Nat. 16:183-186.

Knowles, C. J., C. J. Stoner, and S. P. Gieb. 1982. Selective use of black-tailed prairie dog towns by Mountain Plovers. Condor 84:71-74.

Krebs, J. R., and N. B. Davies. 1993. An introduction to behavioural ecology, third edition. Oxford, U.K.: Blackwell Scientific Publ. 420 pp.

McCaffery, B. J., T. A. Sordahl, and P. Zahler. 1984. Behavioral ecology of the Mountain Plover in northeastern Colorado. Wader Study Group Bull. 40:18-21.

Miller, B. J., and F. L. Knopf. 1993. Growth and survival of Mountain Plovers. J. Field Ornithol. 64:500-506.

Oberholser, H. C. 1974. The bird life of Texas (2 vols.) Austin: Univ. Texas Press. 1069 pp.

Olson, S. L., and D. Edge. 1985. Nest site selection by Mountain Plovers in northcentral Montana. J. Range Manage. 38:280-282.

Reynolds, J. D. 1987. Mating system and nesting biology of the red-necked phalarope *Phalaropus lobatus*: what constitutes polyandry? Ibis 129:225-242.

Samson, F. B., and F. L. Knopf. 1994. Prairie conservation in North America. Bioscience 44:418-421.

Sandoz, M. 1954. The buffalo hunters: the story of the hide men. New York: Hastings House. 372 pp.

Sclater, W. L. 1912. A history of the birds of Colorado. London: Witherby and Co. 576 pp.

Shackford, J. S. 1991. Breeding ecology of the Mountain Plover in Oklahoma. Bull. Oklahoma Ornithol. Soc. 24:9-13.

Shackford, J. S., D. M. Leslie, Jr., and W. D. Harden. 1999. Range-wide use of cultivated fields by Mountain Plovers during the breeding season. J. Field Ornithol. 70:114-120.

Small, A. 1994. California birds: their status and distribution. Vista, Calif.: Ibis Publ. Co.

Terres, J. K. 1980. The Audubon Society encyclopedia of North American birds. New York: Alfred A. Knopf. 1109 pp.

Underwood, M. M., Jr. 1994. Final environmental impact statement for management strategy for Mountain Plover, Pawnee National Grassland.

Walker, J. 1955. Mountain Plover. Audubon 57:210-212.

AMPHIBIANS & REPTILES

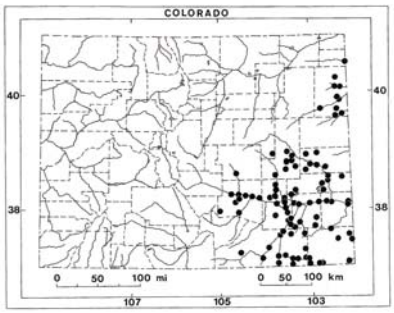
Rana blairi (Plains Leopard Frog)

Photo by G. Hammerson

Taxonomy
Class: Amphibia
Order: Anura
Family: Ranidae
Genus: *Rana*

Taxonomic Comments: Formerly considered part of the *Rana pipiens* species complex; hybridizes with *Rana pipiens* and *Rana sphenocephala*. No subspecies are recognized.
CNHP Ranking: G5 S3

State/Federal Status: Species of special concern (Colorado).



Plains leopard frog distribution in Colorado (Hammerson 1999)

Habitat Comments: Plains leopard frogs are found in a variety of temporary and permanent aquatic habitats, including streams, rivers, ponds, lakes, ditches, and marshes (Degenhardt *et al.* 1996). They are often found great distances from water and for that reason they sometimes are known as "meadow frogs" (Wright and Wright 1949). Mass movements away from breeding ponds are sometimes undertaken by adults and young after summer rains (Fitch 1958). *Rana blairi* is better adapted to dry conditions than the closely-related *Rana pipiens* (Gillis 1975, 1979) and often uses shallow, muddy waters (Scott and Jennings 1985, Stebbins 1985).

Distribution: *Rana blairi* ranges westward from Indiana to southern South Dakota and eastern Colorado, and southward to Texas; isolated populations occur in southern Illinois, New Mexico, and Arizona (Stebbins 1985, Brown 1992, Conant and Collins 1998). In Colorado, the range of the plains leopard frog generally is complementary to that of the northern leopard frog (*Rana pipiens*) (Hammerson 1999). *Rana blairi* is found at elevations below 6,000 ft (1,850 m) in the Arkansas River drainage in southeastern Colorado and in the Republican River drainage of northeastern Colorado (Hammerson 1999).

Important Life History Characteristics: *Rana blairi* breeds from February through October (Pace 1974), with peak breeding activity occurring after heavy rains (Gillis 1975, Lynch 1985). Eggs, which hatch into tadpoles within three weeks, are laid in large clusters attached to submerged vegetation in shallow water (Degenhardt *et al.* 1996). Depending upon the timing (month) of egg deposition, the tadpoles may metamorphose into frogs or they may overwinter and then transform during the next spring (Gillis 1975, Scott and Jennings 1985). In the autumn, the adults dig into the mud and debris on the bottoms of streams and ponds to overwinter (Collins 1993). The adults feed mainly on non-aquatic insects (Hartman 1906, Hammerson 1999). To escape predators, they tend to leap away from water rather than toward it, in contrast to the responses of many other species of

frogs (Degenhardt *et al.* 1996, Hammerson 1999). When captured by predators, these frogs emit characteristic, explosive distress calls (Hammerson 1999). Dispersal distances of eight km have been recorded for the species (Gillis 1975).

Known Threats and Management Issues: *Rana blairi* has become scarce or absent at some locations where non-native bullfrogs have been introduced (Hammerson 1982). *Rana blairi* eggs and young are readily eaten by bullfrog larvae (Ehrlich 1979), and large bullfrog larvae that have overwintered could greatly reduce the reproductive success of plains leopard frogs (Hammerson 1999). Moreover, adult bullfrogs consume adult plains leopard frogs (Mackessy 1998).

Brown, L. E. 1992. *Rana blairi*. Cat. Amer. Amphib. and Reptiles 536:1-6.

Collins, J. T. 1993. Amphibians and reptiles in Kansas, third edition, revised. Lawrence: Univ. Kansas Mus. Nat. Hist. 397 pp.

Conant, R., and J. T. Collins. 1998. A field guide to reptiles and amphibians: eastern and central North America, third edition, expanded. Boston: Houghton Mifflin. 616 pp.

Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and reptiles of New Mexico. Albuquerque: Univ. New Mexico Press. 431 pp.

Ehrlich, D. 1979. Predation by bullfrog tadpoles (*Rana catesbeiana*) on eggs and newly hatched larvae of the plains leopard frog (*Rana blairi*). Bull. Maryland Herpetological Soc. 15:25-26.

Fitch, H. S. 1958. Home ranges, territories, and seasonal movements of vertebrates of the Natural History Reservation. Univ. Kansas Publ. Mus. Nat. Hist.11:63-326.

Gillis, J. E. 1975. Characterization of a hybridizing complex of leopard frogs. Ph.D. dissertation, Colo. St. Univ., Fort Collins. 136 pp.

Gillis, J. E. 1979. Adaptive differences in the water economies of two species of leopard frogs from eastern Colorado (Amphibia, Anura, Ranidae). J. Herpetol. 13:445-450.

Hammerson, G. A. 1982. Bullfrog eliminating leopard frogs in Colorado? Herpetological Rev. 13:115-116.

Hammerson, G. A. 1999. Amphibians and reptiles in Colorado, second edition. Niwot, Colo.: Univ. Press of Colo. and Colo. Div. Wildl. 484 pp.

Hartman, F. A. 1906. Food habits of Kansas lizards and batrachians. Trans. Kansas Acad. Sci. 20:225-229.

Lynch, J. D. 1985. Annotated checklist of the amphibians and reptiles of Nebraska. Trans. Nebraska Acad. Sci. 13:33-57.

Pace, A. E. 1974. Systematic and biological studies of the leopard frogs (*Rana pipiens* complex) of the United States. Misc. Publ. Mus. Zool.Univ. Mich. 148:1-140.

Scott, N. J., Jr., and R. D. Jennings. 1985. The tadpoles of five species of New Mexican leopard frogs. Occas. Pap. Mus. Southwest. Biol. 3:1-21.

Stebbins, R. C. 1954. Amphibians and reptiles of western North America. New York: McGraw-Hill. 536 pp.

Stebbins, R. C. 1985. A field guide to western reptiles and amphibians, second edition. Boston: Houghton Mifflin. 336 pp.

Wright, A. H., and A. A. Wright. 1949. Handbook of frogs and toads of the United States and Canada, third edition. Ithaca: Comstock Publ. Co. 640 pp.

Northern leopard frog (*Rana pipiens*) G5 S3

The decline of frogs throughout the world in recent years has been of great concern to scientists. The northern leopard frog has disappeared in some parts of Colorado. The exact cause of the declines is unknown and needs further investigation (Hammerson 1982). Part of the statewide decline may be due to predation by the increasingly abundant bullfrog (*Rana catesbiana*), which is native to the eastern U. S., but introduced in Colorado.

The northern leopard frog inhabits springs, slow moving streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes, usually in permanent, clear water with rooted aquatic vegetation. In summer, the frog commonly occupies wet meadows and fields. The species appears to be faring better in eastern Montrose County than in other parts of the state. We documented five populations of northern leopard frogs in eastern Montrose County, in varied habitats, from wetlands along the Uncompahgre River to the banks of small ponds and irrigation ditches in the valleys and on the Uncompahgre Plateau. They inhabited both natural and irrigation-created wetlands.

INSECTS

Polites origenes rhena
Cross-line skipper

Taxonomy:
Class: Insecta Order: Lepidoptera
Family: Hesperiidae Genus: *Polites*

Taxonomic Comments: Two subspecies occur in North America: *origenes* and *rhena*. *P. o. rhena* occurs in Colorado (Ferris and Brown 1981). *Polites origenes rhena* is larger and more tawny than eastern subspecies *origenes* (Ferris and Brown 1981). Resembles *P. themistocles*, but is slightly larger and darker; the mail stigma is straight, females usually (and males often) have faint hindwing spots, and females nearly lack an orange upper-forewing streak.

CNHP Ranking: G5S3

Distribution: Global range: This species occurs in the eastern United States and southern Canada, with disjunct populations in meadows adjoining the Rocky Mountain foothills, and similar habitats in the Black Hills of South Dakota (Ferris and Brown 1981). State range: Colorado Front Range lower foothill canyons where they open onto the plains (Ferris and Brown 1981, Brown 1957). Known from 13 counties in Colorado (Stanford and Opler 1993): Adams, Arapahoe, Boulder, Custer, Douglas, El Paso, Elbert, Fremont, Gilpin, Jefferson, Larimer, Las Animas, Pueblo.

Known Locations in the Study Site: This species has been successfully located at Beech Open Space, Foothills Trail (both located within the North Boulder Grasslands site), and at the Shanahan Grasslands site.

Habitat Comments: Elevational range: 1645 to 2316m in Colorado (5400-7600 feet). Grasslands, serpentine or sandy barrens, canyon openings near plains (Pyle 1981). Swales and grassy meadows adjoining rocky mountain foothills (Ferris and Brown 1981).

Phenology: One brood emerging in mid-June through July in Colorado (Ferris and Brown 1981, Pyle 1981). Males perch all day in grassy swales and valley bottoms to await females (Scott 1986).

Larval Hostplant: In Colorado, the hostplant is suspected to be big bluestem (*Andropogon gerardii*) by habitat association (Stanford pers. comm).

Known Threats and Management Issues: Habitat, especially along the foothills of Colorado is subject to continued destruction of prairie habitat by conversion to cropland and for urban developments. Additionally, habitat loss may be attributed to increased tree density into former prairie habitat.

Atrytonopsis hianna turneri
Dusted skipper

Taxonomy:
Class: Insecta Order: Lepidoptera
Family: Hesperiidae Genus: *Atrytonopsis*

Taxonomic Comments: Two subspecies are recognized in North America: *turneri* and *hianna* (Miller and Brown 1981). Subspecies *turneri* occurs in Colorado (Ferris and Brown 1981). Subspecies *hianna* has few or no under-hindwing spots when compared with subspecies *turneri* (Scott 1986).

CNHP Rank: G4G5S2

Distribution: Global range: Frequents northeastern North America from Saskatchewan and New England south to Florida and the Ozark Plateau. Several disjunct western populations comprise the Rocky Mountain subspecies. New Mexico records require confirmation (Ferris and Brown 1981). State range: Found in the foothills of the Arkansas headwaters, and in Larimer County (Stanford and Opler 1993). Larimer County populations are apparently peripheral to eastern populations, while Arkansas drainage populations are believed to be disjunct (Scott 1986, Ferris and Brown 1981). Known from five Colorado counties: Custer, El Paso, Fremont, Larimer, Pueblo.

Known Locations within the Study Site: This species was not successfully located in the study site. It has not been documented from Boulder County, although it is expected (Stanford pers. comm.).

Habitat Comments: Inhabits Transition Zone open dry fields, open woodland, and prairie gulches (Scott 1986). This skipper is found in bluestem grasslands, and often on acid pine or pine-oak barrens or prairies (Pyle 1981). Inhabits relatively undisturbed canyons and open pine woodlands from 1615 to 2195m (5300 to 7200 feet). These habitats are subject to fire, and the skipper must either survive burning or be a good colonist (Opler and Krizek 1984, Pyle 1981).

Phenology: In Colorado, it has one brood, with adults flying from May to mid-June. Males perch in flat clearings or gullies, usually on the ground to await females. Adults will nectar on beardtounge (*Penstemon*) species, and on blackberry, strawberry, and clover (Scott 1986).

Larval Hostplants: Big bluestem (*Andropogon gerardii*) and little bluestem (*Schizachyrium scoparium*).

Known Threats and Management Issues: Given its lower Front Range distribution, it may be threatened by increasing development. Fire suppression is changing the character of its Front Range habitat reducing the open shrublands and woodlands preferred by this species.

Celastrina sp 1
Hop-feeding azure

Taxonomy:
Class: Insecta Order: Lepidoptera
Family: Lycaenidae Genus: *Celastrina*

Taxonomic Comments: An undescribed species (Opler pers. comm.). The placement of the hops-feeding azure within the summer azures is uncertain. Some believe that it is a distinct species (Wright 1995).

CNHP Rank: G2QS2

Distribution: Global range: Foothills of eastern Colorado Rockies (Wright 1995). State range: Probably endemic to the Front Range of Colorado (Opler pers. comm.). Documented from eight Front Range counties in Colorado : Adams, Arapahoe, Boulder, Douglas, El Paso, Elbert, Jefferson, Larimer (Stanford and Opler 1996, Ellingson et al. 1996, Stanford and Opler 1993).

Known Locations within the Study Site: In 1996, a single individual was documented from Coyote Canyon with no evidence of hostplant or a colony. Efforts to locate the colony were not successful in 1996, and was thus treated as a stray (Pineda 1997). In 1997, a colony of this species was successfully located in Skunk Canyon. Skunk Canyon is located in the Boulder Foothills site.

Habitat Comments: Minimum elevation: 1615m (5300 feet). Typical habitats are mountain canyons and valleys that contain permanent water and contain wild hops (*Humulus lupulus*) (Wright 1995, Fisher 1981), found clambering over shrubs and rocky slopes in canyons and foothills (Weber 1976).

Larval Hostplant: Wild hops (*Humulus lupulus*).

Phenology: Adult flight: Single brood, emerging late May to June; rarely found through mid-July (Wright 1995, Opler pers. comm.). Larval hostplant is wild hops (*Humulus lupulus*).

Known Threats and Management Issues: Extensive urbanization and alteration of habitat is a major threat. Noxious exotic plants, recreational development and water development also continue to threaten lower foothill canyons (even on public lands). Formal description may increase collecting pressure (Opler pers. comm.). Management should include control of noxious weeds and control tree density. Hostplant is an early-successional plant requiring open, sunny areas within canyon habitats. There is some concern that collection of the flowers (for beer brewing purposes) may affect larval food supply.

Callophrys mossii schryveri
Schryver's elfin

Taxonomy:
Class: Insecta Order: Lepidoptera
Family: Lycaenidae Genus: *Callophrys*

Taxonomic Comments: Formerly in the genus *Incisalia*. The *mossii* complex is separated from the *fotis* complex due to its preference for stonecrop (*Sedum* spp.) as a hostplant. Subspecies *schryveri* occurs in Colorado (Ferris and Brown 1981). *C. mossii schryveri* range is restricted to the Rocky Mountain region. Contrasts with species *C. mossii* in that it is smaller, has a lighter dorsal color in the male; and more contrasting ventral hindwing markings (Scott 1986).

CNHP Rank: G4T3S2S3

Distribution: Global range: The *mossii* complex is confined to the northwestern portion of the United States and southwestern Canada extending south to central California and to east-central Colorado (Stanford and Opler 1993, Ferris and Brown 1981). State range: Foothills and lower montane canyons between 1828 and 2438m (6000 to 8000 feet) (Ferris and Brown 1981). Known from nine counties in the Colorado Rocky Mountain region (Stanford and Opler 1993): Boulder, Clear Creek, Douglas, El Paso, Fremont, Gilpin, Jefferson, Larimer, and Pueblo.

Known Locations in the Study Site: This subspecies has been successfully located in Gregory Canyon and Tenderfoot Trail. Both of these occurrences are within the Boulder Foothills site.

Habitat Comments: Elevational range is between 1828 and 2438m (6000 to 8000 feet). Occupies suitable habitat in Transition to lower Canadian Zone wooded canyons containing the hostplant (Scott 1986). Canyons with steep rocky slopes, mossy bare summits and ridges, brushy foothill ravines, sagebrush hillsides and flats (Pyle 1981).

Phenology: One brood. Flies from February to June depending on locality (Pyle 1981). It is one of the first non-hibernating butterflies to appear in the spring (Ferris and Brown 1981). Stays close to the hostplant, flying erratically and close to the ground, often in inaccessible areas. Males come to damp earth, perching on low shrubs or ground, females are more reclusive and remain higher up on slopes (Pyle 1981). Adults are local, moving an average of only 50m for males and 52m for females over a lifetime (Scott 1986). Males perch all day on shrubs in gulches and on slopes to await females (Scott 1986).

Larval Hostplant: Stonecrop (*Sedum lanceolatum*).

Known Threats and Management Issues: The greatest current threats are extensive urbanization and alteration of habitat. Noxious exotic plants, recreational development and water development continue to threaten lower foothill canyons (even on public lands). The absence of fire and increased tree density may negatively impact hostplant.

MAMMALS

Vulpes velox (Swift Fox)

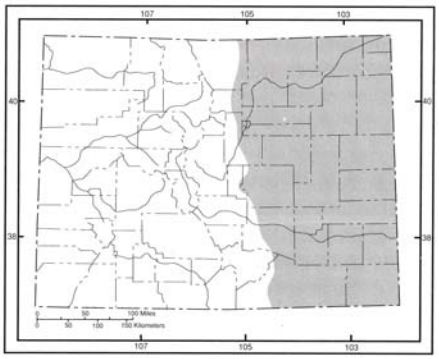
Photo by J. P. Gionfriddo

Taxonomy
Class: Mammalia
Order: Carnivora
Family: Canidae
Genus: *Vulpes*

Taxonomic Comments: Some taxonomists consider swift foxes and kit foxes (*Vulpes macrotis*) to be distinct subspecies within a single species which they designate *Vulpes velox*. We follow the more common classification in which these two foxes are regarded as distinct species.

CNHP Ranking: G3 S3

State/Federal Status: Forest Service sensitive; species of special concern (Colorado).



Swift fox distribution in Colorado (from Fitzgerald

Habitat Comments: Swift foxes inhabit shortgrass, midgrass, and mixed-grass prairies, where they prefer well-drained, friable soils (Bee *et al.* 1981, Nowak 1999). Dens are excavated on slopes, ridges, or flat areas that afford good views of surrounding lands (Fitzgerald *et al.* 1994).

Distribution: Swift foxes formerly occurred throughout the Great Plains from Canada to Texas. Populations were severely depleted from the 1830s through the 1950s. Swift fox numbers remain very low throughout the northern portion of the species' former range. In Colorado, swift foxes inhabit the eastern third of the state, where they live in low densities on areas of native shortgrass prairie (Fitzgerald *et al.* 1994).

Important Life History Characteristics: The basic social unit in swift foxes consists of the mated pair (which remain together year-round and may mate for life) and their young (Nowak 1999). Occasionally a male may mate and live with two adult females. Young swift foxes are born in March or early April and remain with their parents at den sites through late August. This strong, protracted family group association at the den is unique among canids (Kilgore 1969, Hillman and Sharps 1978). Swift foxes use dens throughout the year (Egoscue 1979) and have been characterized as the most subterranean (burrow dependent) of native North American foxes (Seton 1929). Swift

fox dens are important ecological features that provide refuges, breeding sites, and sources of food for a variety of vertebrates and invertebrates (Kilgore 1969).

Known Threats and Management Issues: Swift foxes occupy only 10 percent of their former range (Smeeton 1993, Allardyce 1995). Swift fox populations plummeted during the last half of the 18th century and the early 19th century as a consequence of widespread and indiscriminate poisoning that targeted wolves (*Canus lupus*) (Stephens and Anderson 2005). Other factors responsible for the reductions in their distribution and population sizes include trapping, hunting, predator and rodent control programs, attacks by unleashed dogs, collisions with automobiles, and habitat loss (Bailey 1926, Kilgore 1969, Hillman and Sharps 1978). Swift foxes are not as cautious as many other canids and so they are trapped and poisoned relatively easily (Egoscue 1979). In southeastern Colorado, predation by coyotes is a major source of mortality of swift foxes (Andersen *et al.* 1998).

Allardyce, D. A. 1995. Twelve-month finding for a petition to list the swift fox as endangered. Federal Register 60:31663-31666.

Andersen, D. E., T. R. Laurion, J. R. Cary, R. S. Sikes, and E. M. Gese. 1998. Ecology of swift fox in southeastern Colorado. In Swift fox symposium: ecology and conservation of swift foxes in a changing world. U. S. Geological Survey, Canadian Wildlife Service, The Wildlife Society, and the Swift Fox Conservation Society.

Bailey, V. 1926. A biological survey of North Dakota. North Amer. Fauna 49. 226 pp.

Bee, J. W., G. E. Glass, R. S. Hoffmann, and R. R. Patterson. 1981. Mammals in Kansas. Univ. Kansas Mus. Nat. Hist., Public Educ. Ser. No. 7. 300 pp.

Egoscue, H. J. 1979. *Vulpes velox*. Mammalian Species 122:1-5.

Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. 1994. Mammals of Colorado. Niwot, Colo.: Univ. Press of Colo. 467 pp.

Hillman, C. N., and J. C. Sharps. 1978. Return of swift fox to northern great plains. Proc. South Dakota Acad. Sci. 57:154-162.

Kilgore, D. L., Jr. 1969. An ecological study of the swift fox (*Vulpes velox*) in the Oklahoma panhandle. Amer. Midl. Nat. 81:512-534.

Nowak, R. M., editor. 1999. Walker's mammals of the world, sixth edition. Baltimore: Johns Hopkins Univ. Press. 1936 pp.

Seton, E. T. 1929. Lives of game animals. Garden City, N.Y.: Doubleday and Co. 746 pp.

Smeeton, C. 1993. Mee yah chah, the swift fox. Canid News 1:7-9.

Stephens, R.M. and S.H. Anderson. 2005. Swift Fox (*Vulpes velox*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/swiftfox.pdf (accessed April 6, 2005).

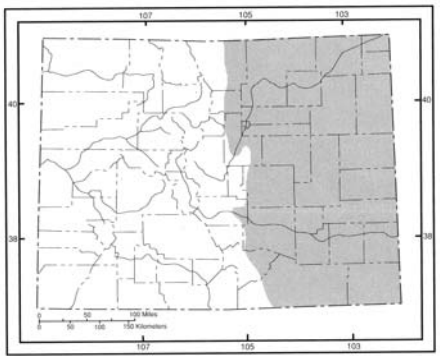
Cynomys ludovicianus (Black-tailed Prairie Dog)

Taxonomy
Class: Mammalia
Order: Rodentia
Family: Sciuridae
Genus: *Cynomys*

Taxonomic Comments: Of the two recognized subspecies, only one occurs in Colorado (*Cynomys ludovicianus ludovicianus*).

CNHP Ranking: G4 S4

State/Federal Status: None.



Black-tailed prairie dog distribution in Colorado (from Fitzgerald et al. 1994)

Habitat Comments: *Cynomys ludovicianus* occupies shortgrass and mixed-grass prairie habitats with well-drained, friable soils that permit the construction of complex burrow systems. The shrubs and herbaceous vegetation within colonies of black-tailed prairie dogs tend to be shorter than those located within colonies of Gunnison's and white-tailed prairie dogs because black-tailed prairie dogs clip tall plants (without eating them) to increase the detectability of approaching aerial and terrestrial predators (King 1955, Pizzimenti 1975, Fitzgerald *et al.* 1994, Hoogland 1995).

Distribution: Of the five species of prairie dogs in North America, *Cynomys ludovicianus* is the most widely distributed (Hoogland 1996). Today the species occurs in isolated patches throughout its historical range, which included much of the Great Plains from southern Saskatchewan (Canada) to northern Mexico (Hoogland 1996). In Colorado, black-tailed prairie dogs occupy suitable included in the eastern 40 percent of the state, inhabiting shortgrass prairie and other areas of low-growing vegetation (Fitzgerald *et al.* 1994). Throughout its range, the species occurs in much lower densities and in smaller colonies than it did historically (Fitzgerald *et al.* 1994, Hoogland 1996).

Important Life History Characteristics: Black-tailed prairie dogs are diurnal, burrowing, colonially-dwelling, herbivorous rodents that are active above-ground throughout the year. Unlike the Gunnison's, Utah, and white-tailed prairie dogs, they do not hibernate (Hoogland 1996). Within a colony, black-tailed prairie dogs live in territorial family groups called coteries, which include an adult male, usually two or three adult females, and several non-breeding yearlings and juveniles (Hoogland 1996). Males tend to disperse (leave the natal coterie) before they mature sexually; this behavior reduces inbreeding and may result in colonization of new areas (Hoogland 1982, Garrett and Franklin 1988). Rather than dispersing, females tend to remain in the natal coterie throughout their lives; for this reason, females within a coterie usually are closely related (Hoogland 1995). Through their foraging behavior and their clipping of tall plants, black-tailed prairie dogs have

dramatically changed the composition of plant communities throughout their range (Hoogland 1996). In addition, the presence of prairie dog towns greatly increases the zoological diversity of prairie ecosystems by attracting predators and many other animals (i.e., Tyler 1970, Campbell and Clark 1981, Clark *et al.* 1982, Hoogland 1995).

Known Threats and Management Issues: Black-tailed prairie dogs have been subjected to extermination programs (public and private) for more than 100 years (Hoogland 1995). Outbreaks of plague (caused by the bacillus *Yersinia pestis* and transmitted by fleas) continue to reduce or even eliminate some colonies (Barnes 1982, Ebasco Serv., Inc. 1989). As in the past, however, the greatest threats to black-tailed prairie dogs come from humans due to conflicts with agricultural and other economic interests.

Barnes, A. M. 1982. Surveillance and control of bubonic plague in the United States. Symp. Zool. Soc. Lond. 50: 237-270.

Campbell, T. M., III, and T. W. Clark. 1981. Colony characteristics and vertebrate associates of white-tailed and black-tailed prairie dogs in Wyoming. Amer. Midl. Nat. 105:269-275.

Clark, T. W., T. M. Campbell, III, D. G. Socha, and D. E. Casey. 1982. Prairie dog colony attributes and associated vertebrate species. Great Basin Nat. 42:572-582.

Ebasco Serv., Inc. 1989. Black-tailed prairie dog activity survey. Interim report (June). U.S. Fish and Wildl. Serv., Rocky Mtn. Arsenal, Denver, Colo. 12 pp. [Cited by Robinette *et al.* 1995.]

Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. 1994. Mammals of Colorado. Niwot, Colo.: Univ. Press of Colo. 467 pp.

Garrett, M. G., and W. L. Franklin. 1988. Behavioral ecology of dispersal in the black-tailed prairie dog. J. Mammal. 69:236-250.

Hoogland, J. L. 1982. Prairie dogs avoid extreme inbreeding. Science 215:1639-1641.

Hoogland, J. L. 1995. The black-tailed prairie dog. Chicago: Univ. Chicago Press. 557 pp.

Hoogland, J. L. 1996. *Cynomys ludovicianus*. Mammalian Species 535:1-10.

King, J. A. 1955. Social behavior, social organization, and population dynamics in a black-tailed prairie dog town in the Black Hills of South Dakota. Contributions from the Laboratory of Vertebrate Biology, University of Michigan 67:1-123.

Pizzimenti, J. J. 1975. Evolution of the prairie dog genus *Cynomys*. Occasional papers of the Museum of Natural History, University of Kansas 39:1-73.

Tyler, J. D. 1970. Vertebrates in a prairie dog town. Proc. Oklahoma Acad. Sci. 50:110-113.

Zapus hudsonius preblei (Preble's Meadow Jumping Mouse)

Taxonomy
Class: Mammalia
Order: Rodentia
Family: Zapodidae
Genus: *Zapus*

Taxonomic Comments: Some taxonomists use the family name "Dipodidae" instead of "Zapodidae."

CNHP Ranking: G5T2 S1

State/Federal Status: Forest Service sensitive; listed as federally threatened; species of special concern (Colorado).

Photo by P. Schuerman

Preble's meadow jumping mouse distribution in Colorado (CNHP data)

Habitat Comments: Preble's meadow jumping mouse occurs in areas of lush, rank vegetation along watercourses and in marshy areas and wet meadows (Krutzsch 1954, Whitaker 1972, Fitzgerald *et al*. 1994). Habitats often are characterized by high species richness and well-developed vegetative cover (Meaney *et al*. 1997). Hibernacula generally are located upslope (and may be quite distant) from areas used in summer (Hafner 1997).

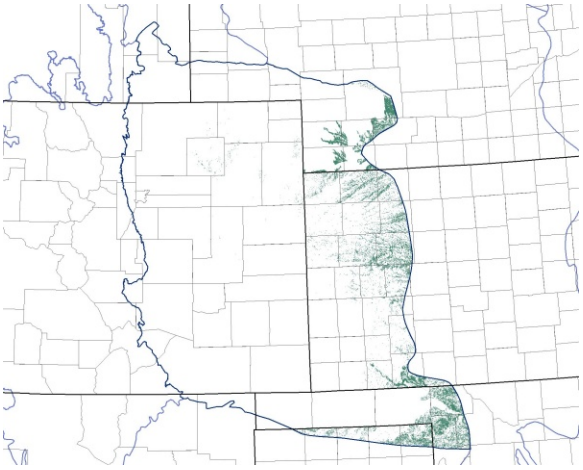
Distribution: *Z. h. preblei* historically occurred in marshy areas along the upper drainages of the North Platte River in southeastern Wyoming (Long 1965, Clark and Stromberg 1987) and on the western edge of the Colorado piedmont along the South Platte River drainage south to the Denver area (Armstrong 1972). Current distribution is severely restricted and fragmented; habitats are likely to continue to decline both qualitatively and quantitatively (Hafner *et al.* 1998)

Important Life History Characteristics: *Zapus hudsonius preblei* hibernates for a longer period than most mammalian hibernators: from September or October through late April or early May each year (Whitaker 1963, 1972). During the 4-6 month period of activity each spring/summer, jumping mice feed on seeds, fruits, fungi, and insects; they do not cache food but store body fat before hibernating (Fitzgerald *et al.* 1994, Nowak 1999). Jumping mice generally are nocturnal and crepuscular, but they sometimes are active in daylight (Whitaker 1963, Fitzgerald *et al.* 1994). For protection, jumping mice construct nests of grasses, leaves, or other plant material. Nests are placed in protected locations beneath logs or shrubs and are usually underground but well above the water table (Fitzgerald *et al.* 1994). When hot summer weather reduces the availability of mesic habitat, Preble's meadow jumping mice sometimes abandon their home ranges and wander widely in search of moist sites (Fitzgerald *et al.* 1994:291, Nowak 1999).

Known Threats and Management Issues: The replacement of natural wetlands by reservoirs and by agricultural and urban development has severely impacted many populations (Fitzgerald *et al.* 1994, Garza 1995). Preble's meadow jumping mouse may have been extirpated over most of its former range in Wyoming by extensive overgrazing (habitat loss) and pesticide use (Hafner *et al.* 1998). Conservation of critical mesic forb-grassland habitats and the dispersal corridors that connect isolated patches of habitat is essential to the continued survival of this subspecies (Hafner 1997).

ECOLOGICAL SYSTEMS

S. Kettler



(COMPLEX)
Blacktailed Prairie Dog Town Grassland Complex
ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS SHRUB HERBACEOUS ALLIANCE
Artemisia tridentata ssp. *wyomingensis* / Mixed Grasses Shrub Herbaceous Vegetation
HESPEROSTIPA COMATA - BOUTELOUA GRACILIS HERBACEOUS ALLIANCE
Hesperostipa comata - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation
Hesperostipa comata - Carex filifolia Herbaceous Vegetation
Hesperostipa comata - Carex inops ssp. *heliophila* Herbaceous Vegetation
Hesperostipa comata Colorado Front Range Herbaceous Vegetation
JUNIPERUS VIRGINIANA FOREST ALLIANCE
Juniperus virginiana var. *virginiana* / *Schizachyrium scoparium* Forest
KRASCHENINNIKOVIA LANATA DWARF-SHRUB HERBACEOUS ALLIANCE
Krascheninnikovia lanata / Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation
PASCOPYRUM SMITHII HERBACEOUS ALLIANCE
Pascopyrum smithii - Bouteloua gracilis Herbaceous Vegetation
Pascopyrum smithii - Hesperostipa comata Central Mixedgrass Herbaceous Vegetation
Pascopyrum smithii Herbaceous Vegetation
POA PRATENSIS SEMI-NATURAL HERBACEOUS ALLIANCE
Poa pratensis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation
SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SPARSELY VEGETATED ALLIANCE
Sarcobatus vermiculatus / Sporobolus airoides Sparse Vegetation
SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE
Juniperus virginiana var. *virginiana / Schizachyrium scoparium - Bouteloua curtipendula* Great Plains Herbaceous Vegetation
Schizachyrium scoparium - Bouteloua (curtipendula, gracilis) - Carex filifolia Herbaceous Vegetation
Schizachyrium scoparium - Bouteloua curtipendula - Bouteloua gracilis Central Plains Herbaceous Vegetation
Schizachyrium scoparium - Bouteloua curtipendula - Nassella leucotricha Herbaceous Vegetation
Schizachyrium scoparium - Bouteloua curtipendula Chalkflat Herbaceous Vegetation
Schizachyrium scoparium - Bouteloua curtipendula Loess Mixedgrass Herbaceous Vegetation
Schizachyrium scoparium - Bouteloua curtipendula Red Hills Herbaceous Vegetation
Schizachyrium scoparium - Bouteloua curtipendula Western Great Plains Herbaceous Vegetation
Schizachyrium scoparium - Lesquerella gordonii - Castilleja purpurea var. *citrina* Herbaceous Vegetation
YUCCA GLAUCA SHRUB HERBACEOUS ALLIANCE (
Yucca glauca / Calamovilfa longifolia Shrub Herbaceous Vegetation

Overview: The mixedgrass or midgrass prairie system ranges from South Dakota to northern Texas and is bordered by the shortgrass prairie on the western edge and the tallgrass prairie to the east. The loessal regions in west-central Kansas and central Nebraska, the Red Hills region of south-central Kansas and northern Oklahoma are all located within this system. Although the greater part of the mixedgrass prairie lies to the east of Colorado, the western extent of this system has probably moved in and out of what is now eastern Colorado during much of the Holocene, as climatic conditions alternated between wetter and drier. In the sandhills of eastern Colorado, midgrass prairie dominated large areas in the early years of the 1900s. By the late 1940s, most of these communities had been replaced by shortgrass or sandsage communities, due to the effects of

grazing and drought (McGinnies et al. 1991). Due to its position on the periphery of the range of the midgrass prairie ecological system, Colorado has probably never supported extensive tracts of this type.

Characteristic species: The majority of mixedgrass associations in this system are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium*, although other grass species such as *Bouteloua curtipendula*, , *Andropogon gerardii, Hesperostipa comata, Sporobolus heterolepis*, and *Bouteloua gracilis* are often present. Numerous forb and sedge species (*Carex* spp.) can also occur within the mixedgrass system in the Western Great Plains. Although forbs do not always significantly contribute to the canopy, they can be very important. Some dominant forb species include *Ambrosia psilostachya, Echinacea angustifolia*, and *Lygodesmia juncea*. Shrubland associations can occur in areas protected from fire due to topographic conditions. Small seeps may occur, especially during the wettest years. Although there are no animal species which are strictly endemic to midgrass prairie, grassland birds such as chestnut-collared longspur, lark bunting, Cassin's sparrow, and grasshopper sparrow do use these mid-height grassland for major portions of their life cycle, and are indicators of a functioning system.

Environment: Differences in topography and soil characteristics also occur across the range of this system. It is often characterized by rolling to extremely hilly landscapes with soils developed from loess, shale, limestone or sandstone parent material. Mollisol soils are most prevalent and range from silt loams and silty clay loams with sandy loams possible on the western edge of the range.

Dynamics: Fire and grazing are the primary processes occurring within the system. The diversity in this mixedgrass system likely reflects both the short- and long-term responses of the vegetation to these often concurrent disturbance regimes. Fire suppression and overgrazing can lead to the invasion of this system by woody species such as *Juniperus virginiana* and *Pinus ponderosa*.

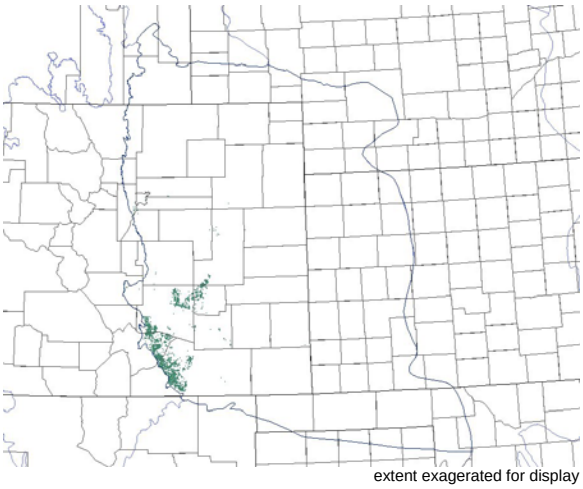
Variation: Because of its position between two other prairie systems, this system contains elements from both shortgrass and tallgrass prairies, which combine to form the midgrass prairie ecological system throughout its range. The distribution, species richness and productivity of plant species within the midgrass ecological system is controlled primarily by environmental conditions, especially soil moisture and topography. The relative dominance of the various grass and forb species within different associations in the system also can strongly depend on the history and degree of natural or human disturbance.

Although this system forms the matrix vegetation in parts of the Central Mixedgrass Prairie ecoregion, it is a large patch system in the Central Shortgrass Prairie ecoregion. In regions where this system is matrix forming, a viable example of this system would be large enough that fire and grazing can occur at spatial and temporal scales approaching those at which they naturally occurred, and viable sizes would range from 5000 to over 100,000 acres. In the Central Shortgrass Prairie, occurrences of this size would simply not be found, and size ranking is adjusted accordingly.

McGinnies, W.J., H.L. Shantz, and W.G. McGinnies. 1991. Changes in Vegetation and Land Use in Eastern Colorado: A Photogaphic Study, 1904 to 1986. US Department of Agriculture, Agricultural Research Service, ARS-85, 165 p

INTER-MOUNTAIN BASINS GREASEWOOD FLAT

R. Rondeau



extent exagerated for display

DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
- *Distichlis spicata - (Scirpus nevadensis)* Herbaceous Vegetation
- *Distichlis spicata* Herbaceous Vegetation

ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Eleocharis palustris* Herbaceous Vegetation

LEYMUS CINEREUS HERBACEOUS ALLIANCE
- *Leymus cinereus* Herbaceous Vegetation

PUCCINELLIA NUTTALLIANA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
- *Puccinellia nuttalliana* Herbaceous Vegetation

SALICORNIA RUBRA SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Salicornia rubra* Herbaceous Vegetation

SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE
- *Sarcobatus vermiculatus / Artemisia* tridentata Shrubland
- *Sarcobatus vermiculatus / Distichlis spicata* Shrubland
- *Sarcobatus vermiculatus / Suaeda moquinii* Shrubland
- *Sarcobatus vermiculatus* Shrubland

SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SPARSELY VEGETATED ALLIANCE
- *Sarcobatus vermiculatus / Juncus balticus* Sparse Vegetation
- *Sarcobatus vermiculatus / Sporobolus airoides* Sparse Vegetation

SARCOBATUS VERMICULATUS SHRUBLAND ALLIANCE (A.1041)
- *Sarcobatus vermiculatus / Bouteloua gracilis* Shrubland

SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation

SPOROBOLUS AIROIDES INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
- *Sporobolus airoides - Distichlis spicata* Herbaceous Vegetation

Overview: The Greasewood Flats ecological system occurs throughout much of the western U.S. in intermountain basins and extends onto the western Great Plains. In the Central Shortgrass Prairie ecoregion occurrences are primarily in the southwestern portion of the ecoregion. Large occurrences are also found in the lower elevations of Colorado's western valleys and throughout much of the San Luis Valley. Greasewood flats are large patch systems confined to specific environments defined by hydrologic regime, soil salinity and texture.

Characteristic species: This ecological system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus*. *Atriplex canescens*, *Atriplex confertifolia*, *Chrysothamnus nauseosus*, *Cylindropuntia candelabra*, or *Krascheninnikovia lanata* may be present to codominant. The herbaceous layer, if present, is usually dominated by graminoids such as *Sporobolus arioides*, *Distichlis spicata*, and *Bouteloua gracilis*. Small patches of *Sporobolus airoides*, *Distichlis spicata* (where water remains ponded the longest), or *Eleocharis palustris* herbaceous types may be found within the shrubland system.

Environment: Greasewood flats are typically found near drainages on stream terraces and flats, on alluvial fans along streams or arroyos, or they may form rings around playas. Sites usually have saline soils, a shallow water table and flood intermittently, but remain dry for most of the growing season.

Dynamics: Because greasewood flats are tightly associated with saline soils and groundwater that is near the surface, the primary ecological process that maintains greasewood flats is groundwater recharge, rather than surface water. *Sarcobatus vermiculatus* is often found on sites with high water tables that are intermittently flooded. Groundwater flows and depth are one of the most important driving factors in maintaining this system. *Sarcobatus vermiculatus*, like many facultative halophytes, is tolerant of alkaline and saline soil conditions that allow the species to occur in sites with less interspecific competition (Ungar et al. 1969, Bransen et al. 1976). The shrub also occurs on extremely arid non-saline sites.

Although most studies indicate that *Sarcobatus vermiculatus* is relatively unharmed by fire, the degree of damage may vary according to season of burn, fuel loading, and intensity of fire. Fire will top kill *S. vermiculatus*, but the shrub will promptly resprout from the root crown (Daubenmire 1970).

Sarcobatus vermiculatus is not ordinarily browsed, but Daubenmire (1970) found that under heavy stocking rates, the shrubs will develop a compact canopy.

R. Rondeau

Variation: This system occurs as a mosaic of communities with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus*. Greasewood dominated vegetation can occur as a narrow band along a channel, or in a mosaic of communities where composition and density of the shrub and understory species vary with depth to water table, salinity and alkalinity, soil texture, and past land use or disturbance. Occurrences may be surrounded by grasslands, stabilized sand dunes, wet meadow systems, mixed salt desert scrub, sandsage, or shortgrass prairie. Hanson (1929) described stands in south-central Colorado and found that pure stands of *S. vermiculatus* and *Distichlis spicata* are more common on strongly saline/alkaline sites with fine-textured soil and shallow water tables, whereas stands with mixed shrubs such as *Chrysothamnus* or *Artemisia* are more common on drier, coarser textured, low-alkaline sites. *Sporobolus airoides* is found on dry, strongly alkaline sites, and *Pascopyrum smithii* is most common on less alkaline, moist, sites in low lying areas.

Branson, F. A., R. F. Miller, and I. S. McQueen. 1976. Moisture relationships in twelve northern desert shrub communities near Grand Junction, Colorado. Ecology 57:1104-1124.

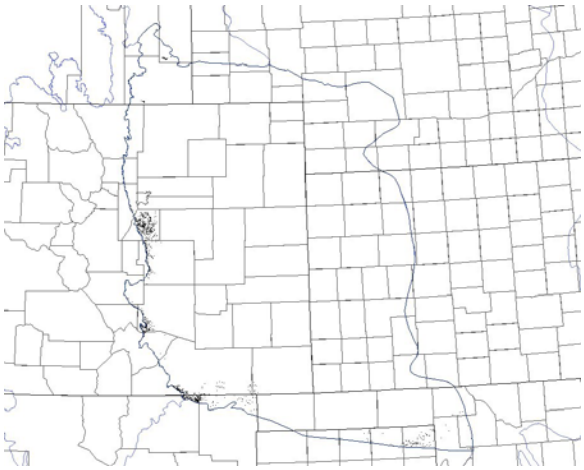
Daubenmire, R. F. 1970. Steppe vegetation of Washington. Washington State University Agricultural Experiment Station Technical Bulletin No. 62. 131 pp.

Hanson, H. C. 1929. Range resources of the San Luis Valley. Pages 5-61 in: Range resources of the San Luis Valley. Bulletin 335. Colorado Experiment Station, Fort Collins, CO.

Ungar, I. A., W. Hogan, and M. McClennand. 1969. Plant communities of saline soils at Lincoln, Nebraska. The American Midland Naturalist 82(2):564-577.

ROCKY MOUNTAIN GAMBEL OAK-MIXED MONTANE SHRUBLAND

S. Spackman



JUNIPERUS SCOPULORUM WOODLAND ALLIANCE
Juniperus scopulorum - Quercus gambelii Woodland [Provisional]
QUERCUS GAMBELII SHRUBLAND ALLIANCE
Quercus gambelii - Cercocarpus montanus / (Carex geyeri) Shrubland
Quercus gambelii / Hesperostipa comata Shrubland [Provisional]
Quercus gambelii / Paxistima myrsinites Shrubland
Quercus gambelii / Symphoricarpos oreophilus Shrubland

Overview: This large patch ecological system is primarily found in the mountains, plateaus and foothills in the southern Rocky Mountains and Colorado Plateau. In the Central Shortgrass Prairie ecoregion, these shrublands are most commonly found along the dry foothills, mesas, canyons, and outcrops at the edge of the western Great Plains from approximately 4600 to 6800 ft in elevation, and are often intermixed with juniper or ponderosa woodlands. There may be inclusions of other mesic montane shrublands with *Quercus gambelii* absent or as a relatively minor component. This ecological system intergrades with the lower montane-foothills shrubland system and shares many of the same site characteristics.

Characteristic species: The vegetation is typically dominated by *Quercus gambelii* alone or codominant with other shrubs such as *Cercocarpus montanus, Prunus virginiana, Purshia tridentata, Symphoricarpos oreophilus,* or *Symphoricarpos rotundifolius*. The inclusion of *Amelanchier* spp. is uncommon in the Central Shortgrass Prairie ecoregion, in contrast to occurrences further west. Vegetation types in this system may occur as sparse to dense shrublands composed of moderate to tall shrubs. Occurrences may be multi-layered, with some short shrubby species occurring in the understory of the dominant overstory species. Occurrences can range from dense thickets with little understory to relatively mesic mixed-shrublands with a rich understory of shrubs, grasses and forbs. These shrubs often have a patchy distribution with grass growing in between.

Scattered trees are often present in stands and typically include species of *Pinus* or *Juniperus*. The herbaceous layer is sparse to moderately dense, ranging from 1-40% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua gracilis, Aristida* spp., *Carex inops, Carex geyeri, Elymus arizonicus, Eragrostis* spp., *Festuca* spp., *Koeleria macrantha, Muhlenbergia* spp., and *Stipa* spp. Many forb and fern species can occur, but none have much cover. Commonly present forbs include *Achillea millefolium, Artemisia* spp., *Geranium* spp., *Maianthemum stellatum, Thalictrum fendleri*, and *Vicia americana*. Ferns include species of *Cheilanthes* and *Woodsia*. Annual grasses and forbs are seasonally present, and weedy annuals are often present, at least seasonally.

Environment: This ecological system typically occupies the lower slope positions of the foothill and lower montane zones where it may occur on level to steep slopes, cliffs, escarpments, rimrock slopes, rocky outcrops, and scree slopes. Climate is semi-arid and characterized by mostly hot-dry summers with mild to cold winters and annual precipitation of 25 to 70 cm. Precipitation mostly occurs as winter snows but may also consist of some late summer rains. Substrates are variable and include soil types ranging from calcareous, heavy, fine-grained loams to sandy loams, gravelly loams, clay loams, deep alluvial sand, or coarse gravel. Soils are typically poorly developed, rocky to very rocky, and well-drained. Parent materials include alluvium, colluvium, and residuum derived from igneous, metamorphic, or sedimentary rocks such as granite, gneiss, limestone, quartz, monzonite, rhyolite, sandstone, schist, and shale.

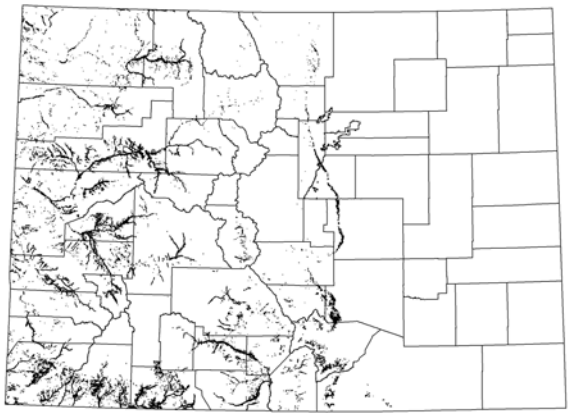
S. Spackman

Dynamics: Fire typically plays an important role in this system, causing die-back of the dominant shrub species in some areas, promoting stump sprouting of the dominant shrubs in other areas, and controlling the invasion of trees into the shrubland system. Density and cover of *Quercus gambelii* often increases after fire. Natural fires typically result in a system with a mosaic of dense shrub clusters and openings dominated by herbaceous species. In some instances these associations may be seral to the adjacent ponderosa and juniper woodlands.

Variation: Although this is a shrub-dominated system, some trees may be present. In older occurrences, or occurrences on mesic sites, some of the shrubs may acquire tree-like sizes.

ROCKY MOUNTAIN LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND

K. Carsey



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ACER NEGUNDO SEASONALLY FLOODED FOREST ALLIANCE
- *Acer negundo / Equisetum arvense* Forest

ACER NEGUNDO TEMPORARILY FLOODED FOREST ALLIANCE
- *Acer negundo - Populus angustifolia / Cornus sericea* Forest
- *Acer negundo / Cornus sericea* Forest
- *Acer negundo / Prunus virginiana* Forest

ACER NEGUNDO TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Acer negundo / Betula occidentalis* Woodland
- *Acer negundo / Disturbed Understory* Woodland

FORESTIERA PUBESCENS TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Forestiera pubescens* Shrubland

FRAXINUS ANOMALA TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Fraxinus anomala* Woodland

JUNIPERUS SCOPULORUM TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Juniperus scopulorum / Cornus sericea* Woodland

JUNIPERUS SCOPULORUM WOODLAND ALLIANCE
- *Juniperus scopulorum* Woodland

PINUS PONDEROSA TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Pinus ponderosa / Alnus incana* Woodland

POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE
- *Populus angustifolia - Populus deltoides - Salix amygdaloides* Forest
- *Populus angustifolia / Lonicera involucrata* Forest
- *Populus angustifolia* Sand Dune Forest

POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Populus angustifolia - Juniperus scopulorum* Woodland
- *Populus angustifolia - Picea pungens / Alnus incana* Woodland
- *Populus angustifolia - Pinus ponderosa* Woodland
- *Populus angustifolia - Pseudotsuga menziesii* Woodland
- *Populus angustifolia / Alnus incana* Woodland
- *Populus angustifolia / Betula occidentalis* Woodland
- *Populus angustifolia / Cornus sericea* Woodland
- *Populus angustifolia / Crataegus rivularis* Woodland
- *Populus angustifolia / Prunus virginiana* Woodland
- *Populus angustifolia / Rhus trilobata* Woodland
- *Populus angustifolia / Salix (monticola, drummondiana, lucida)* Woodland
- *Populus angustifolia / Salix drummondiana - Acer glabrum* Woodland
- *Populus angustifolia / Salix exigua* Woodland
- *Populus angustifolia / Salix irrorata* Woodland
- *Populus angustifolia / Salix ligulifolia - Shepherdia argentea* Woodland
- *Populus angustifolia / Symphoricarpos albus* Woodland

POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior)* Woodland
- *Populus deltoides / Symphoricarpos occidentalis* Woodland
- *Populus deltoides ssp. wislizeni / Rhus trilobata* Woodland

PSEUDOTSUGA MENZIESII TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Pseudotsuga menziesii / Betula occidentalis* Woodland
- *Pseudotsuga menziesii / Cornus sericea* Woodland

RHUS TRILOBATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE
- *Rhus trilobata* Intermittently Flooded Shrubland

SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Salix exigua - Salix ligulifolia* Shrubland
- *Salix exigua* / Barren Shrubland
- *Salix exigua* / Mesic Graminoids Shrubland
- *Salix exigua* Temporarily Flooded Shrubland

SALIX AMYGDALOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Salix amygdaloides* Woodland

SALIX IRRORATA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Salix irrorata* Shrubland

SHEPHERDIA ARGENTEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Shepherdia argentea* Shrubland

Overview: The Rocky Mountain Lower Montane Riparian Woodland and Shrubland system is found throughout the Rocky Mountain region within a broad elevation range from approximately 2950 to 9100 ft (900 to 2800 m). In Colorado this system is primarily found in the western half of the state at elevations above 5100 ft (1550 m), where it occurs within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component.

Characteristic species: Dominant trees may include *Acer negundo, Populus angustifolia, Populus* x *acuminata, Populus balsamifera, Populus deltoides, Populus fremontii, Pseudotsuga menziesii, Picea pungens, Salix amygdaloides*, or *Juniperus scopulorum*. Dominant shrubs include *Acer glabrum, Alnus incana, Betula occidentalis, Cornus sericea, Crataegus rivularis, Forestiera pubescens, Prunus virginiana, Rhus trilobata, Salix monticola, Salix drummondiana, Salix exigua, Salix irrorata, Salix lucida, Shepherdia argentea*, or *Symphoricarpos* spp. The exotic trees *Elaeagnus angustifolia, Tamarix* spp., and *Salix fragilis* are common in some stands. The upland vegetation surrounding this riparian system ranges from grasslands to forests.

Environment: This ecological system is found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. It can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. It may also occur in upland areas of mesic swales and hillslopes below seeps and springs. The climate in the range of this system is continental with typically cold winters and hot summers. Surface water is generally high for variable periods. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Highly stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Soils are fine-textured with organic material over coarser alluvium. Some soils are more developed due to a slightly more stable environment and greater input of organic matter.

Dynamics: This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. These woodlands and shrublands grow within a continually changing alluvial environment due to the ebb and flow of the river, and riparian vegetation is constantly being “re-set” by flooding disturbance.

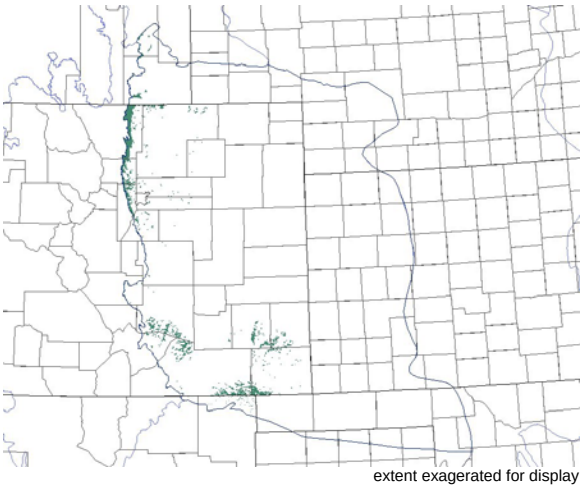
Variation: This ecological system contains early-, mid- and late-seral riparian plant associations. It also contains non-obligate riparian species. Cottonwood communities are early-, mid- or late-seral, depending on the age class of the trees and the associated species of the occurrence (Kittel et al. 1999). Mature cottonwood occurrences do not regenerate in place, but by "moving" up and down a river reach. Over time a healthy riparian area supports all stages of cottonwood communities (Kittel et al. 1999).

G. Kittel

Kittel, G. M., E. VanWie, M. Dam, R. Rondeau, S. Kettler, A. McMullen, and J. Sanderson. 1999. A Classification of Riparian Wetland Plant Associations of Colorado: User Guide to the Classification Project, Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.

ROCKY MOUNTAIN LOWER MONTANE-FOOTHILL SHRUBLAND

S. Neid



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ARTEMISIA FRIGIDA SHRUBLAND ALLIANCE
- *Artemisia frigida / Bouteloua gracilis* Shrubland [Provisional]

ARTEMISIA NOVA SHRUB HERBACEOUS ALLIANCE
- *Artemisia nova / Leymus salinus* ssp. *salmonis* Shrub Herbaceous Vegetation

CERCOCARPUS MONTANUS SHRUB HERBACEOUS ALLIANCE
- *Cercocarpus montanus / Muhlenbergia emersleyi* Shrub Herbaceous Vegetation

CERCOCARPUS MONTANUS SHRUBLAND ALLIANCE
- *Cercocarpus montanus - Rhus trilobata / Andropogon gerardii* Shrubland
- *Cercocarpus montanus / Achnatherum scribneri* Shrubland
- *Cercocarpus montanus / Bouteloua curtipendula* Shrubland
- *Cercocarpus montanus / Elymus lanceolatus* ssp. *lanceolatus* Shrubland
- *Cercocarpus montanus / Hesperostipa comata* Shrubland
- *Cercocarpus montanus / Hesperostipa neomexicana* Shrubland
- *Cercocarpus montanus / Muhlenbergia montana* Shrubland
- *Cercocarpus montanus / Muhlenbergia pauciflora* Shrubland
- *Cercocarpus montanus / Pseudoroegneria spicata* Shrubland
- *Cercocarpus montanus / Rhus trilobata* var. *trilobata* Shrubland
- *Cercocarpus montanus* var. *paucidentatus / Petrophyton caespitosum* Shrubland

PRUNUS VIRGINIANA SHRUBLAND ALLIANCE
- *Prunus virginiana - (Prunus americana)* Shrubland

PURSHIA TRIDENTATA SHRUBLAND ALLIANCE
- *Purshia tridentata / Artemisia frigida / Hesperostipa comata* Shrubland
- *Purshia tridentata / Muhlenbergia montana* Shrubland
- *Purshia tridentata / Hesperostipa comata* Shrub Herbaceous Vegetation

RHUS TRILOBATA SHRUB HERBACEOUS ALLIANCE
- *Rhus trilobata / Festuca idahoensis* Shrub Herbaceous Vegetation
- *Rhus trilobata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation
- *Rhus trilobata* Rocky Mountain Shrub Herbaceous Vegetation [Provisional]

RIBES CEREUM SHRUBLAND ALLIANCE
- *Ribes cereum / Leymus ambiguus* Shrubland

SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Symphoricarpos occidentalis* Shrubland

Overview: This large patch ecological system is found in the foothills, canyon slopes and lower mountains of the Rocky Mountains and ranges from southern New Mexico extending north into Wyoming, and west into the Intermountain region. It is common where *Quercus gambelii* is absent such as the northern Colorado Front Range and in drier foothills and prairie hills. This system is generally drier than Rocky Mountain Gambel Oak-Mixed Montane Shrubland, but may include mesic montane shrublands where *Quercus gambelii* does not occur. It may occur as a mosaic of two or three plant associations often surrounded by grasslands or woodlands.

Characteristic species: Scattered trees or inclusions of grassland patches or steppe may be present, but the vegetation is typically dominated by a variety of shrubs including *Amelanchier utahensis, Cercocarpus montanus, Purshia tridentata, Rhus trilobata, Ribes cereum, Symphoricarpos oreophilus,* or *Yucca glauca*. Grasses are represented as species of *Muhlenbergia, Bouteloua, Hesperostipa,* and *Pseudoroegneria spicata*.

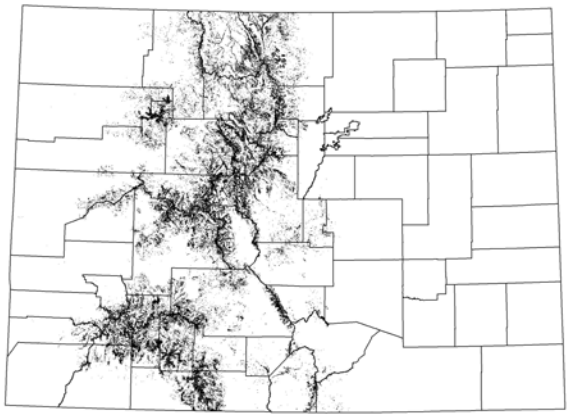
Environment: These shrublands occur between 5,000-9,000 feet (1500-2900 m) elevations and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth.

Dynamics: Fires play an important role in this system as the dominant shrubs usually have a severe die-back, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth.

S. Neid

ROCKY MOUNTAIN SUBALPINE-MONTANE RIPARIAN SHRUBLAND

M. Aitken



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ACER GLABRUM TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Acer glabrum* Drainage Bottom Shrubland

ALNUS INCANA SEASONALLY FLOODED SHRUBLAND ALLIANCE
- *Alnus incana - Salix (monticola, lucida, ligulifolia)* Shrubland
- *Alnus incana / Equisetum arvense* Shrubland

ALNUS INCANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Alnus incana - Salix drummondiana* Shrubland
- *Alnus incana / Calamagrostis canadensis* Shrubland
- *Alnus incana / Cornus sericea* Shrubland
- *Alnus incana* / Mesic Forbs Shrubland
- *Alnus incana* / Mesic Graminoids Shrubland

BETULA NANA SEASONALLY FLOODED SHRUBLAND ALLIANCE
- *Betula nana* / Mesic Forbs - Mesic Graminoids Shrubland

BETULA OCCIDENTALIS SEASONALLY FLOODED SHRUBLAND ALLIANCE
- *Betula occidentalis* / Mesic Graminoids Shrubland
- *Betula occidentalis* Shrubland

BETULA OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Betula occidentalis / Cornus sericea* Shrubland
- *Betula occidentalis / Maianthemum stellatum* Shrubland

CORNUS SERICEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Cornus sericea / Heracleum maximum* Shrubland
- *Cornus sericea* Shrubland

DASIPHORA FRUTICOSA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Dasiphora fruticosa* ssp. *floribunda / Deschampsia caespitosa* Shrubland

SALIX BEBBIANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Salix bebbiana* / Mesic Graminoids Shrubland
- *Salix bebbiana* Shrubland

SALIX BOOTHII SEASONALLY FLOODED SHRUBLAND ALLIANCE
- *Salix (boothii, geyeriana) / Carex aquatilis* Shrubland
- *Salix boothii / Calamagrostis canadensis* Shrubland

SALIX BOOTHII TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Salix boothii - Salix geyeriana* Shrubland
- *Salix boothii / Carex utriculata* Shrubland
- *Salix boothii / Deschampsia caespitosa - Geum rossii* Shrubland
- *Salix boothii* / Mesic Forbs Shrubland
- *Salix boothii* / Mesic Graminoids Shrubland

SALIX BRACHYCARPA SEASONALLY FLOODED SHRUBLAND ALLIANCE
- *Salix brachycarpa / Carex aquatilis* Shrubland
- *Salix brachycarpa* / Mesic Forbs Shrubland

SALIX DRUMMONDIANA SEASONALLY FLOODED SHRUBLAND ALLIANCE
- *Salix drummondiana / Carex utriculata* Shrubland

SALIX DRUMMONDIANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Salix drummondiana / Calamagrostis canadensis* Shrubland
- *Salix drummondiana* / Mesic Forbs Shrubland

SALIX GEYERIANA SEASONALLY FLOODED SHRUBLAND ALLIANCE
- *Salix geyeriana / Calamagrostis canadensis* Shrubland
- *Salix geyeriana / Carex aquatilis* Shrubland
- *Salix geyeriana / Carex utriculata* Shrubland

SALIX GEYERIANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Salix geyeriana - Salix monticola / Calamagrostis canadensis* Shrubland
- *Salix geyeriana - Salix monticola* / Mesic Forbs Shrubland
- *Salix geyeriana* / Mesic Forbs Shrubland
- *Salix geyeriana* / Mesic Graminoids Shrubland
- *Salix geyeriana / Poa palustris* Shrubland

SALIX LIGULIFOLIA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Salix ligulifolia Shrubland
SALIX LUCIDA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Salix lucida ssp. *caudata / Rosa woodsii* Shrubland
SALIX MONTICOLA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Salix monticola / Angelica ampla Shrubland
Salix monticola / Calamagrostis canadensis Shrubland
Salix monticola / Carex aquatilis Shrubland
Salix monticola / Carex utriculata Shrubland
Salix monticola / Mesic Forbs Shrubland
Salix monticola / Mesic Graminoids Shrubland
SALIX PLANIFOLIA SEASONALLY FLOODED SHRUBLAND ALLIANCE
Salix planifolia / Caltha leptosepala Shrubland
Salix planifolia / Carex aquatilis Shrubland
Salix planifolia / Carex utriculata Shrubland
Salix planifolia / Carex scopulorum Shrubland
Salix planifolia / Mesic Forbs Shrubland [Provisional]
SALIX PLANIFOLIA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Salix planifolia / Calamagrostis canadensis Shrubland
Salix planifolia / Deschampsia caespitosa Shrubland
SALIX WOLFII SEASONALLY FLOODED SHRUBLAND ALLIANCE
Salix wolfii / Carex aquatilis Shrubland
Salix wolfii / Carex utriculata Shrubland
SALIX WOLFII TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Salix wolfii / Deschampsia caespitosa Shrubland
Salix wolfii / Fragaria virginiana Shrubland
Salix wolfii / Mesic Forbs Shrubland

Overview: This system is found throughout the Rocky Mountain cordillera from New Mexico north into Montana, and also occurs in mountainous areas of the Intermountain region and Colorado Plateau. These montane to subalpine riparian shrublands may occur as narrow bands of shrubs lining streambanks and alluvial terraces, or as extensive willow carrs in broad, hummocky floodplains and subalpine valleys.

Characteristic species: The dominant shrubs reflect the large elevational gradient and include *Alnus incana, Betula nana, B. occidentalis, Cornus sericea, Salix bebbiana, S. boothii, S. brachycarpa, S. drummondiana, S. eriocephala, S. geyeriana, S. liguifolia, S. monticola, S. planifolia,* and *S. wolfii*. Generally the upland vegetation surrounding these riparian systems are either conifer or aspen forests.

Environment: This system is more commonly found at higher elevations, but occurs anywhere from 5,600 to 11,800 ft (1,700-3,595 m). Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. This system often occurs as a mosaic of multiple communities that are shrub- and herb-dominated and includes above-treeline, willow-dominated, snowmelt-fed basins that feed into streams.

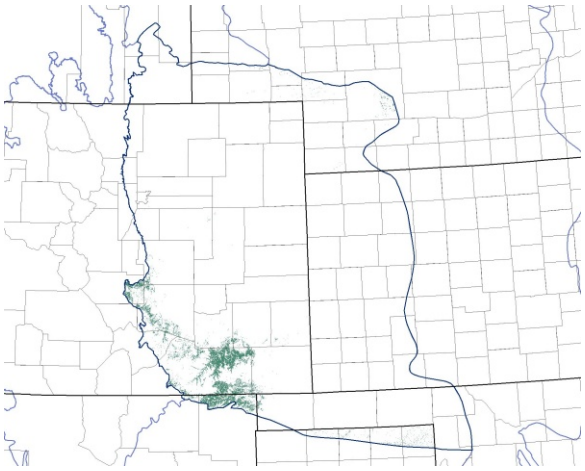
Dynamics: Many of the plant associations included in this system are associated with beaver activity, which can be important for maintaining the health of the riparian ecosystem. Beaver dams abate channel down cutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water table across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment.


A. McMullen

Variation: At lower elevations in the range of this system, occurrences are more likely to be non-willow shrublands dominated by *Alnus incana, Betula occidentalis,* or *Cornus sericia.* At the highest elevations communities dominated by short-statured species such as *Betula nana, Salix brachycarpa, S. planifolia,* and *S. wolfii* are most common.

SOUTHERN ROCKY MOUNTAIN JUNIPER WOODLAND AND SAVANNA

S. Kettler



JUNIPERUS MONOSPERMA WOODLAND ALLIANCE

Juniperus monosperma / Andropogon hallii Woodland
Juniperus monosperma / Bouteloua curtipendula Woodland
Juniperus monosperma / Bouteloua eriopoda Woodland
Juniperus monosperma / Bouteloua gracilis Woodland
Juniperus monosperma / Cercocarpus montanus - Ribes cereum Woodland
Juniperus monosperma / Cercocarpus montanus Woodland
Juniperus monosperma / Hesperostipa neomexicana Woodland

Juniperus monosperma / Krascheninnikovia lanata Woodland
Juniperus monosperma - Rhus trilobata / Schizachyrium scoparium Woodland

JUNIPERUS SCOPULORUM WOODLAND ALLIANCE

Juniperus scopulorum / Schizachyrium scoparium Woodland

Overview: The Juniper Woodland and Savanna ecological system occupies the lower and warmest elevations, primarily along the east and south slopes of the southern Rockies and Arizona-New Mexico mountains. Juniper woodlands and savannas are usually found just below the lower elevational range of ponderosa pine and often intermingle with grasslands and shrublands. In the canyons and tablelands of the southern Great Plains this system also forms extensive cover at some distance from the mountain front. In the Central Shortgrass Prairie, this system is largely confined to the southwestern portion of the ecoregion and forms an extensive matrix with the Southwestern Great Plains Canyon ecological system.

Characteristic species: The Juniper Woodland and Savanna system is best described as a savanna that has widely spaced mature (>150 years old) juniper trees and occasionally *Pinus edulis*. *Juniperus monosperma* and *Juniperus scopulorum* are the dominant tall shrubs or scattered short trees, though there may be inclusions of more dense juniper woodlands. Graminoid species are similar to those found in Western Great Plains Shortgrass Prairie, with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. In addition, succulents such as species of *Yucca* and *Opuntia* are typically present.

Environment: Occupies the lower and warmer elevations, growing from about 4,260 to 6,000 feet (1,300-1,830 m) in a semi-arid climate.

Dynamics: Although juniper woodlands and savannas are expected to occur naturally on the landscape, the extent and quality of this system has been severely altered since the early 1900's. Numerous studies have shown that juniper has encroached on shrublands and grasslands (e.g., Blackburn and Tueller 1970, West 1999). Processes that influence the formation and persistence of juniper savannas include climate, grazing, fires, tree harvest, and insect-pathogen outbreaks (West 1999; Eager 1999). Alteration of fire intensity and frequency, historic heavy livestock grazing, and changes in climate has led to various densities of younger trees occurring on some sites that were once shrublands or grasslands (West 1999, Commons et al. 1999).

Variation: Within a given region, the density of trees, both historically and currently, is strongly related to topoedaphic gradients. Less steep sites, especially those with finer textured soils, are where savannas, grasslands, and shrub steppes have occurred in the past. Juniper stands on these gentler slopes may have been larger but more savanna-like, with very open upper canopy and high grass production.

R. Rondeau

Blackburn, W. H., and P. T. Tueller. 1970. Pinyon and juniper invasion in black sagebrush communities in east-central Nevada. Ecology 51:841-848.

Commons M. L., R. K. Baydack and C. E. Braun. 1999. Sage grouse response to pinyon-juniper management. Pages 238-239 in S. B. Monsen and R. Stevens, eds., Proceedings: ecology and management of pinyon-juniper communities within the Interior West. U.S. Dept. Agric., Forest Service, Rocky Mountain Research Station, Proc. RMRS-P-9 Ogden, UT . 411 pp.

Eager, T. J. 1999. Factors affecting the health of pinyon pine trees (*Pinus edulis*) in the pinyon-juniper woodlands of western Colorado. Page 397 in S. B. Monsen and R. Stevens, eds., Proceedings: ecology and management of pinyon-juniper communities within the Interior West. U.S. Dept. Agric., Forest Service, Rocky Mountain Research Station, Proc.

West, N. E. 1999. Distribution, composition, and classification of current Juniper-Pinyon woodlands and savannas across western North America. Pages 20-23 in S. B. Monsen and R. Stevens, eds., Proceedings: ecology and management of pinyon-juniper communities within the Interior West. U.S. Dept. Agric., Forest Service, Rocky Mountain Research Station, Proc. RMRS-P-9 Ogden, UT . 411.

WESTERN GREAT PLAINS CLIFF, OUTCROP, AND SHALE BARRENS

G. Kittel

map not available

ADIANTUM CAPILLUS-VENERIS SATURATED HERBACEOUS ALLIANCE
- *Adiantum capillus-veneris - Thelypteris ovata* var. *lindheimeri* Herbaceous Vegetation

ARENARIA HOOKERI BARRENS HERBACEOUS ALLIANCE
- *Arenaria hookeri* Barrens Herbaceous Vegetation

ARTEMISIA LONGIFOLIA SPARSELY VEGETATED ALLIANCE
- *Artemisia longifolia - Calamovilfa longifolia* Sparse Vegetation

CERCOCARPUS MONTANUS SPARSELY VEGETATED ALLIANCE

FRANKENIA JAMESII DWARF-SHRUBLAND (PROPOSED)
- *Frankenia jamesii/ Achnatherum hymenoides* [undescribed]
- *Glossopetalon spinescens* var. *meionandrum - Frankenia jamesii* [undescribed]

JUNIPERUS MONOSPERMA WOODLAND ALLIANCE
- *Juniperus monosperma / Bouteloua curtipendula* Woodland
- *Juniperus monosperma / Bouteloua eriopoda* Woodland
- *Juniperus monosperma / Bouteloua gracilis* Woodland
- *Juniperus monosperma / Cercocarpus montanus - Ribes cereum* Woodland
- *Juniperus monosperma / Cercocarpus montanus* Woodland
- *Juniperus monosperma / Hesperostipa neomexicana* Woodland

LESQUERELLA (GORDONII, OVALIFOLIA) HERBACEOUS ALLIANCE
- *Lesquerella (gordonii, ovalifolia) - Schizachyrium scoparium* Herbaceous Vegetation

OPEN CLIFF SPARSELY VEGETATED ALLIANCE
- Limestone Butte Sparse Vegetation
- Sandstone Butte Sparse Vegetation
- Sandstone Dry Cliff Sparse Vegetation
- Sandstone Great Plains Dry Cliff Sparse Vegetation
- Sandstone Great Plains Xeric Butte - Bluff Sparse Vegetation

PRUNUS VIRGINIANA SHRUBLAND ALLIANCE

RHUS TRILOBATA SHRUB HERBACEOUS ALLIANCE
- *Rhus trilobata* Rocky Mountain Shrub Herbaceous Vegetation

ROCK OUTCROP SPARSELY VEGETATED ALLIANCE
- Shale Barren Slopes Sparse Vegetation
- Siltstone - Sandstone Rock Outcrop Sparse Vegetation

SEDUM NUTTALLIANUM SPARSELY VEGETATED ALLIANCE
- *Sedum nuttallianum - Selaginella peruviana* Granitic Outcrop Sparse Vegetation

Overview: This system includes cliffs, outcrops, breaks and barrens throughout the Western Great Plains. In the northern Central Shortgrass Prairie ecogregion, this system includes rimrock and erosional remnants of the High Plains escarpment stretching for many miles north of the South Platte River, as well as other isolated buttes and outcrops to the south. In the southwestern portion of the ecoregion, occurrences of this system are most often found Cretaceous bedrock of the Middle and Upper Chalk members of the Smoky Hills Member of the Niobrara Formation. The area between Pueblo and Cañon City contains the highest frequency of such shale barrens in southeastern Colorado (Kelso 1999).

Characteristic species: Cliffs and outcrops support a variety of plant communities, depending on the steepness, exposure, and soil conditions of the site. The tops of the escarpment are often dominiated by the adjacent shortgrass or mixedgrass prairie communities. Vegetation of the cliffs and outcrops is typically

sparse, and often restricted to shelves, cracks and crevices in the rock, or other areas where soil accumulation allows growth. The lack of vegetation on many sites protects them from fire, and in a few instances the rocky cliffs support disjunct populations of foothills species such as *Pinus ponderosa, Juniperus scopulorum, Pinus flexilis,* and *Cercocarpus montanus*. Sheltered areas on the bluff slopes typically support sparse shrub cover of *Rhus trilobata, Prunus virginiana, Ribes* spp., *Artemisia filifolia, Gutierrezia sarothrae, Opuntia polyacantha,* and *Yucca glauca,* along with prairie grasses such as *Bouteloua gracilis, Aristida longiseta, Hesperostipa comata, Bouteloua curtipendula, Calamovilfa longifolia* and *Vulpia octoflora*. Claystone and limestone layers within the sandstone form gravelly barrens that support a characteristic "cushion plant" community that typically includes *Arenaria hookeri, Oenothera caespitosa, Phlox hoodii, Tetraneuris acaulis, Astragalus sericoleucus,* and other species typical of the nearby grasslands. These barrens are also home to the regionally rare plants *Lomatium (Aletes) nuttallii, Cryptantha cana* and *Parthenium (Bolophyta) alpinum*.

Vegetation of the shale barrens is characterized by a "cushion-plant" community, with cover less than 25%, and often much lower. Some occurrences may support a sparse overstory of *Juniperus monosperma.* Typical shrub species are *Frankenia jamesii, Glossopetalon meionandra, Atriplex canescens,* and *Artemisia bigelovii.* Perennial low-growing forbs and sub-shrubs include *Tetraneuris acaulis, Eriogonum* spp., *Oxybaphus rotundifolius, Lesquerella fendleri, Chamaesyce glyptosperma, Townsendia hookeri, Melampodium leucanthum, Zinnia grandiflora, Crypthantha* spp., and *Oönopsis foliosa*. Occurrences may include low cover of bunchgrasses such as *Hesperostipa neomexicana, Achnatherum hymenoides, Aristida purpurea,* and *Bouteloua* spp.. As this community grades into adjacent communities in more sheltered areas below ridgetops, cover and plant height increases.

Environment: Topography of cliffs and outcrops ranges from steep rocky bluffs below the escarpments and buttes with intervening swales or gullies to smaller breaks and barrens with gentle slopes. The Ogallala, Arikaree, and White River Formations are the most common cliff and outcrop forming substrates, consisting primarily of sandstones of varying hardness, and often interspersed with limestone, ashy claystone, or volcanic tuff. Shale barrens of the Niobrara Formation are also found near the mountain front.

R. Rondeau

Barrens are generally found on shales, soft limestone (chalk), or shale-derived soils, and are characterized by a high percentage of open, rocky ground between the low-growing shrubs and herbaceous cover. Some occurrences have an overstory of sparse juniper, and may include scattered larger shubs and bunchgrasses. Shale substrates often form a rocky "pavement" between plants. For shale barrens, slope angles range from flat on summits to moderately steep on side slopes, and exposures are variable, depending on how uplift, regional erosion, or downcutting has occurred (Kelso 1999). Soils belong to the Penrose series and are typically shallow. Summit flats have shallower soils than slopes, with slope bottoms generally deeper than slope tops (Kelso 1999). In the southern portion of the Western Great Plains, occurrences of this system may be inclusions in the Southwestern Great Plains Canyon ecological system complex.

Dynamics: Drought and wind erosion are the most common natural dynamics affecting this system.

Variation: Substrates are variable from north to south, and can include sandstone, limestone, clay, siltstone, and shale. Vegetation patterns are also variable across the range of the system, and species composition changes with changing latitude.

Kelso, S. 1999. A Comparative Study of the Shale Barrens Flora on the Niobrara Formation in Southeastern Colorado. Report to the Colorado Natural Areas Program.

WESTERN GREAT PLAINS CLOSED DEPRESSION WETLAND

R. Rondeau

map not available

ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
Eleocharis palustris Herbaceous Vegetation
ELEOCHARIS PALUSTRIS TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Eleocharis palustris - (Eleocharis compressa) - Leptochloa fusca ssp. *fascicularis* Herbaceous Vegetation
HETERANTHERA LIMOSA PERMANENTLY FLOODED HERBACEOUS ALLIANCE
Heteranthera limosa - Bacopa rotundifolia - Sagittaria latifolia Herbaceous Vegetation
HORDEUM JUBATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Hordeum jubatum Herbaceous Vegetation
PANICUM OBTUSUM HERBACEOUS ALLIANCE
Panicum obtusum - Buchloe dactyloides Herbaceous Vegetation
Panicum obtusum - Panicum hallii Herbaceous Vegetation
PASCOPYRUM SMITHII HERBACEOUS ALLIANCE
Pascopyrum smithii - (Elymus trachycaulus) Clay Pan Herbaceous Vegetation
PASCOPYRUM SMITHII INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
Pascopyrum smithii - Buchloe dactyloides - (Phyla cuneifolia, Oenothera canescens) Herbaceous Vegetation
PASCOPYRUM SMITHII TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Pascopyrum smithii - Distichlis spicata Herbaceous Vegetation
Pascopyrum smithii - Eleocharis spp. Herbaceous Vegetation
Pascopyrum smithii - Hordeum jubatum Herbaceous Vegetation
PLEURAPHIS MUTICA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
Pleuraphis mutica - Panicum obtusum Herbaceous Vegetation
POLYGONUM SPP. - ECHINOCHLOA SPP. TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Polygonum spp. - *Echinochloa* spp. - *Distichlis spicata* Playa Lake Herbaceous Vegetation
SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE
Sarcobatus vermiculatus / Leymus cinereus Shrubland
SCHOENOPLECTUS AMERICANUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
Schoenoplectus americanus - Eleocharis spp. Herbaceous Vegetation
SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Spartina pectinata - Eleocharis spp. - *Carex* spp. Herbaceous Vegetation

Overview: This system includes a variety of depressional wetlands or playas scattered throughout the Central Shortgrass Prairie ecoregion. Occurrences are primarily upland depressional basins supporting freshwater wetland vegetation. These wetlands are small, shallow, and generally isolated in an extremely localized watershed. The basins are typified by the presence of an impermeable layer such as a dense clay, and hydric soils. They are rarely linked to outside groundwater sources, and are instead dependent on rainwater and nearby runoff. Ponds and lakes associated with this system can experience periodic drawdowns during drier seasons and years, and are often replenished by spring rains.

Characteristic species: Species richness varies considerably among individual examples of this system. Commonly, *Eleocharis* spp., *Hordeum jubatum*, along with *Coreopsis tinctoria*, *Symphyotrichum subulatum (= Aster subulatus)*, and *Polygonum pensylvanicum (= Polygonum bicorne)* are found in the wetter and deeper depression. Shallower depressions in rangelands commonly contain *Pascopyrum smithii* and *Buchloe dactyloides*.

Environment: This system is typified by upland depressional basins with an impermeable layer such as dense clay, and hydric soils. These basins are generally not recharged by groundwater, and depend on precipitation from storms and local runoff for replenishment.

Dynamics: Playas are characterized by irregular hydroperiods; many fill with water only occasionally and dry quickly. These fluctuations in water availability often promote diverse herbaceous plant growth, but the communities that develop will be shaped by the timing and length of inundation or dryness (Smith 2003). Hydrological changes, grazing and conversion to agriculture are the primary threats influencing this system. Many larger playas have been altered by the digging of pits to concentrate precipitation and irrigation runoff for pumping. The circulation of irrigation water through the playa alters the hydroperiod of the playa, making it more erratic and less able to support the characteristic plant and invertebrate species. Playa filling as a result of soil erosion from adjacent tilled cropland also results in an altered hydroperiod. Playas are also likely to receive significant input of herbicides and fertilizers used on adjacent crop land or runoff from livestock production facilities. These anthropogenic inputs generally impair water quality and reduce the diversity and abundance of plants and invertebrates.

Variation: The processes that lead to the formation and maintenance of depressional wetlands in the Great Plains are not completely understood, and occurrences in different areas may be due to different factors, including wind deflation, animal wallowing, and carbonate dissolution processes.

S. Kettler

Smith, L.M. 2003. *Playas of the Great Plains.* University of Texas Press. Austin, TX

WESTERN GREAT PLAINS HERBACEOUS WETLAND
(NORTH AMERICAN ARID WEST EMERGENT MARSH)


G. Doyle

no map available

(POTAMOGETON DIVERSIFOLIUS, STUCKENIA FILIFORMIS) PERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Potamogeton diversifolius* Herbaceous Vegetation
- *Stuckenia filiformis* Herbaceous Vegetation

CALAMAGROSTIS CANADENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Calamagrostis canadensis* Western Herbaceous Vegetation

CAREX (ROSTRATA, UTRICULATA) SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Carex utriculata* Herbaceous Vegetation

CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Carex nebrascensis* Herbaceous Vegetation

CAREX VESICARIA SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Carex vesicaria* Herbaceous Vegetation

DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
- *Distichlis spicata - (Scirpus nevadensis)* Herbaceous Vegetation

ELEOCHARIS (MONTEVIDENSIS, PALUSTRIS, QUINQUEFLORA) SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Eleocharis (montevidensis, palustris, quinqueflora)* Seasonally Flooded Herbaceous Vegetation [Placeholder]

GLYCERIA BOREALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Glyceria borealis* Herbaceous Vegetation

JUNCUS BALTICUS SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Juncus balticus - Carex rossii* Herbaceous Vegetation
- *Juncus balticus* Herbaceous Vegetation

LEMNA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Lemna* spp. Permanently Flooded Herbaceous Vegetation

MYRIOPHYLLUM SIBIRICUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Myriophyllum sibiricum* Herbaceous Vegetation

NYMPHAEA ODORATA - NUPHAR SPP. PERMANENTLY FLOODED TEMPERATE HERBACEOUS ALLIANCE
- *Nuphar lutea* ssp. *polysepala* Herbaceous Vegetation

PHALARIS ARUNDINACEA SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Phalaris arundinacea* Western Herbaceous Vegetation

PHRAGMITES AUSTRALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation

POTAMOGETON FOLIOSUS PERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Potamogeton foliosus* Herbaceous Vegetation

POTAMOGETON SPP. - CERATOPHYLLUM SPP. - ELODEA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Potamogeton natans* Herbaceous Vegetation

RANUNCULUS AQUATILIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Ranunculus aquatilis - Callitriche palustris* Herbaceous Vegetation

SALICORNIA RUBRA SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Salicornia rubra* Herbaceous Vegetation

SCHOENOPLECTUS ACUTUS - (SCHOENOPLECTUS TABERNAEMONTANI) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Schoenoplectus acutus* Herbaceous Vegetation
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation

SCHOENOPLECTUS AMERICANUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Schoenoplectus americanus - Carex* spp. Herbaceous Vegetation
- *Schoenoplectus americanus - Eleocharis palustris* Herbaceous Vegetation
- *Schoenoplectus americanus - Eleocharis* spp. Herbaceous Vegetation
- *Schoenoplectus americanus* Western Herbaceous Vegetation

SCHOENOPLECTUS MARITIMUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Schoenoplectus maritimus* Herbaceous Vegetation

SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Schoenoplectus pungens Herbaceous Vegetation
SPARGANIUM ANGUSTIFOLIUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE
Sparganium angustifolium Herbaceous Vegetation
SPARGANIUM EURYCARPUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE
Sparganium eurycarpum Herbaceous Vegetation
SPARTINA GRACILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
Spartina gracilis Herbaceous Vegetation
SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Spartina pectinata Western Herbaceous Vegetation
SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE
Sporobolus airoides Southern Plains Herbaceous Vegetation
TRIGLOCHIN MARITIMA SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
Triglochin maritima Herbaceous Vegetation
TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani) Sandhills Herbaceous Vegetation
Typha latifolia Western Herbaceous Vegetation
TYPHA DOMINGENSIS SEASONALLY FLOODED TEMPERATE HERBACEOUS ALLIANCE
Typha domingensis Western Herbaceous Vegetation

Overview: This widespread ecological system occurs throughout much of the arid and semi-arid regions of western North America. Natural marshes may occur in depressions in the landscape (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). This system indluces seeps and springs; small wetland ecological systems that are hydrologically supported by groundwater discharge.

Characteristic species: The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus, Typha, Juncus, Potamogeton, Polygonum, Nuphar,* and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna, Potamogeton*, and *Brasenia*) and submergent and floating plants (*Myriophyllum*, *Ceratophyllum*, and *Elodea*).

In the Western Great Plains, seeps and springs provide habitat for a variety of amphibian species, including tiger salamander *(Ambystoma tigrinum),* red-spotted toad *(Bufo punctatus),* Woodhouse toad *(Bufo woodhousi),* chorus frog *(Pseudacris triseriata maculata),* plains leopard frog *(Rana blairi),* Couch's spadefoot toad *(Scaphiopus couchiia),* plains spadefoot toad *(Spea bombifrons),* and New Mexico spadefoot toad *(Spea multiplicalus)* (Mackessey 1998).

Environment: Marshes are frequently or continually inundated, with water depths up to 6 ft (2 m). Water levels may be stable, or may fluctuate 3 ft (1 m) or more over the course of the growing season. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions i (e.g., gleying, high organic content, redoximorphic features). The occurrence of springs depends on the nature and relationship of rocks, especially permeable and impermeable strata, on the position of the water table, and on the topography (Horton 2000).


R. Rondeau

Variation: Seeps differ from springs in that they often periodically dry and consequently support a lower diversity of wetland vegetation. Springs often have a more persistent source of water and thus support a greater diversity of wetland vegetation and often provide aquatic habitat (BLM 2000, Doyle et al. 2002).

Bureau of Land Management. 2000. A Handbook for the Management of Seeps and Springs in the Great Basin. Sada, D.W. (editor), JE. Williams, J.C. Silvey, A. Halford, J. Ramakka, P. Summers, and L. Lewis.

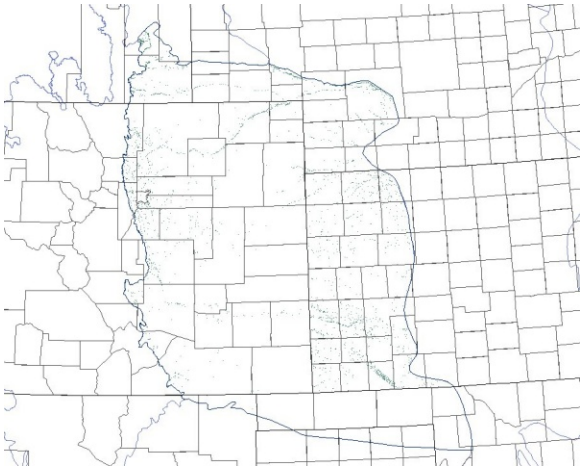
Doyle, G., J. Rocchio, and D. Culver. 2002. Survey of Seeps and Springs within the Bureau of Land Management's Grand Junction Field Office Management Area (Mesa County, CO). Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Horton, G.A. 2000. Water Words Dictionary. Nevada Division of Water Resources, Department of Conservation and Natural Resources. Available online at: http://ndwr.state.nv.us/

Mackessy, Dr. Stephen P. 1998. A Survey of the Herpetofauna of the Comanche National Grasslands in Southeastern Colorado. USDA/Forest Service. 61 pages. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/1999/comaherp/comaherp.htm (Version 04JUN99).

WESTERN GREAT PLAINS RIPARIAN WOODLAND, SHRUBLAND AND HERBACEOUS

S. Kettler



ARTEMISIA CANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Artemisia cana / Pascopyrum smithii* Shrubland

COBBLE/GRAVEL SHORE SPARSELY VEGETATED ALLIANCE
- Riverine Gravel Flats Great Plains Sparse Vegetation

POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE
- *Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior)* Woodland
- *Populus deltoides - (Salix nigra) / Spartina pectinata - Carex* spp. Woodland
- *Populus deltoides / Carex pellita* Woodland
- *Populus deltoides / Muhlenbergia asperifolia* Forest
- *Populus deltoides / Panicum virgatum - Schizachyrium scoparium* Woodland
- *Populus deltoides / Sporobolus airoides* Woodland
- *Populus deltoides / Sporobolus cryptandrus* Woodland
- *Populus deltoides / Symphoricarpos occidentalis* Woodland

SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Symphoricarpos occidentalis* Shrubland

SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE
- *Salix exigua* / Mesic Graminoids Shrubland
- *Salix exigua* / Barren Shrubland

ANDROPOGON GERARDII - (SORGHASTRUM NUTANS) HERBACEOUS ALLIANCE
- *Andropogon gerardii - Sorghastrum nutans* Western Great Plains Herbaceous Vegetation

CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Carex nebrascensis* Herbaceous Vegetation

CAREX PELLITA SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Carex pellita* Herbaceous Vegetation

ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
- *Eleocharis palustris* Herbaceous Vegetation

MUHLENBERGIA ASPERIFOLIA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE
- *Muhlenbergia asperifolia* Herbaceous Vegetation

SCHOENOPLECTUS ACUTUS - (SCHOENOPLECTUS TABERNAEMONTANI) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Scirpus acutus - Scirpus tabernaemontani* Herbaceous Vegetation

SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Schoenoplectus pungens* Herbaceous Vegetation

SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE
- *Spartina pectinata* Western Herbaceous Vegetation

SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation

TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation

Overview: This system is found in the riparian areas of medium and small rivers and streams throughout the Western Great Plains. It is likely most common in the Central Shortgrass Prairie and Northern Great Plains Steppe, but extends west into the Wyoming Basins. Dominant vegetation overlaps broadly with portions of large river floodplain systems, but the overall abundance of vegetation is generally lower. Vegetation may be a mosaic of communities that are not always tree or shrub dominated. Communities within this system range from riparian forests and shrublands to tallgrass wet meadows and gravel/sand flats.

Characteristic Dominant species include *Populus deltoides*, *Salix* spp., *Artemisia cana* ssp. *cana*, *Pascopyrum*

species: *smithii, Sporobolus cryptandrus, Schizachyrium scoparium, Andropogon gerardii,* and *Sorghastrum nutans*. Plant associations of the North American Arid West Emergent Marsh ecological system may occurr along or adjacent to portions of this system.

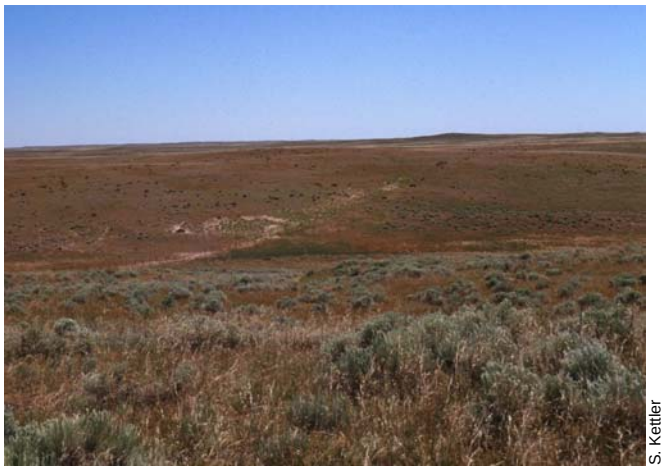
Native amphibians and reptiles (e.g., leopard frogs, spadefoot toads, ornate box turtles), and native prairie fishes are indicators of a healthy riparian shrubland and woodland system.

Environment: This system is composed of associations found on alluvial soils in highly variable landscape settings, from deep cut ravines to wide, braided streambeds. Hydrologically, the associated rivers tend to be more flashy with less developed floodplain than on larger rivers, and typically dry down completely for some portion of the year.

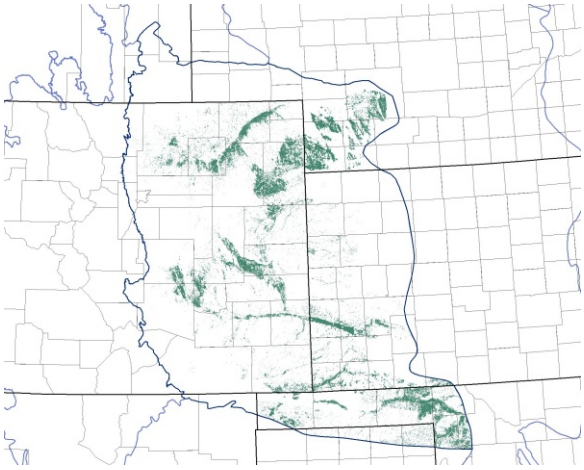
Dynamics: These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. *Tamarix* spp. and less desirable grasses and forbs can invade degraded examples up through central Colorado. Furthermore, groundwater depletion and lack of fire have created additional species changes.

G. Kittel

WESTERN GREAT PLAINS SANDHILL SHRUBLAND



S. Kettler



ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE
- *Artemisia filifolia / Andropogon hallii* Shrubland
- *Artemisia filifolia / Bouteloua (curtipendula, gracilis)* Shrubland
- *Artemisia filifolia / Calamovilfa longifolia* Shrubland
- *Artemisia filifolia / Schizachyrium scoparium - Andropogon hallii* Shrubland
- *Artemisia filifolia / Sporobolus cryptandrus* Shrubland

PRUNUS ANGUSTIFOLIA SHRUBLAND ALLIANCE
- *Prunus angustifolia / Schizachyrium scoparium* Shrubland

QUERCUS HAVARDII SHRUBLAND ALLIANCE
- *Quercus havardii / Sporobolus cryptandrus - Schizachyrium scoparium* Shrubland

Overview: The sandsage prairie ecological system is found primarily in the south-central areas of the Western Great Plains Division. Occurrences range from the Nebraska Sandhill region south to central Texas, although some examples may reach as far north as the Badlands of South Dakota. The greater part of the system occurs in the Central Shortgrass Prairie Ecoregion in eastern Colorado, western Kansas and southwestern Nebraska. The climate is semi-arid to arid for much of the region in which this system occurs. This system is found on somewhat excessively to excessively well-drained, deep sandy soils that are often associated with dune systems and ancient floodplains. In some areas, this system may actually occur as a result of overgrazing in Western Great Plains Tallgrass Prairie or Western Great Plains Sand Prairie. Throughout its range it is closely tied to sandy soils, and this edaphic restriction is characteristic of large patch systems. In addition, this system is likely to intergrade closely with shortgrass prairie, perhaps forming a locally patchy sandsage/shortgrass matrix, and therefore it may be difficult to delimit as a distinct ecological system in places.

Characteristic species: Throughout its range, this system is characterized by a sparse to moderately dense woody layer dominated by *Artemisia filifolia*. These shrubs usually do not grow as clumps but as individuals, and the intervening ground is most often dominated by a sparse to moderately dense layer of tall, mid- or short grasses (Bruner 1939, Steinauer 1989, Ramaley 1939, Dick-Peddie 1993). Associated species can vary with geography, precipitation, disturbance and soil texture. Graminoid species such as *Andropogon hallii, Sporobolus cryptandrus, Calamovilfa longifolia, Calamovilfa gigantea, Hesperostipa comata,* and *Bouteloua* spp. are often associated with this system. Other shrub species may also be present including *Yucca glauca, Prosopis glandulosa, Rhus trilobata,* and *Prunus angustifolia*. A few species such as the shrubs *Prunus pumilla* var. *besseyi* and *Amorpha canescens* and the grasses *Panicum virgatum* and *Sorghastrum nutans* are believed to have been formerly more common, but now much decreased, most likely by cattle grazing throughout the growing season (pers. comm. Harvey Sprock and Ben Berlinger, Colorado NRCS).

Greater and lesser prairie-chickens, Cassin's sparrows, and ornate box turtles are indicators of a healthy sandsage prairie system.

Environment: In eastern Colorado, this system is found in extensive tracts on Quaternary eolian deposits along the South Platte, Arikaree and Republican Rivers, between Big Sandy and Rush Creeks, and along the Arkansas and Cimarron Rivers, where it is contiguous with areas in Kansas (Comer et al. 2003).

Dynamics: Fire and grazing are the most important dynamic processes for this type, although drought stress can impact this system significantly in some areas (Ramaley 1939). Overgrazing can lead to decreasing dominance of some of the grass species such as *Andropogon hallii*, *Calamovilfa gigantea*, *Calamovilfa longifolia* and *Schizachyrium scoparium*.

R. Rondeau

Variation: Colorado's eastern plains exhibit climatic differences from north to south which may be reflected in the local expression of sandsage prairie. Occurrences in southern Colorado experience a longer growing season, lower annual precipitation, and differences in precipitation patterns (Western Regional Climate Center 2004), and may be dominated by different species than northern stands.

In the southern range of this system, *Quercus havardii* may also be present and represents one succession pathway that develops over time following a disturbance. *Quercus havardii* is able to resprout following a fire and thus may persist for long periods of time once established (Wright and Bailey 1982).

Comer, P., S. Menard, M. Tuffly, K. Kindscher, R. Rondeau, G. Jones, G. Steinuaer, and D. Ode. 2003. Upland and Wetland Ecological Systems in Colorado, Wyoming, South Dakota, Nebraska, and Kansas. Report and map (10 hectare minimum map unit) to the National Gap Analysis Program. Dept. of Interior USGS. NatureServe.

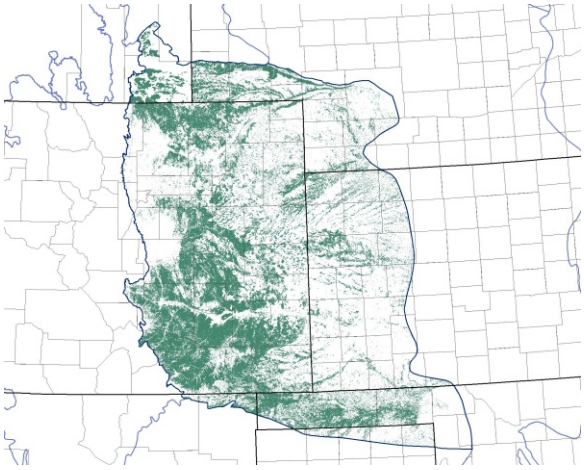
Ramaley, F. 1939. Sand-hill vegetation of northeastern Colorado. Ecological Monographs 9(1):1-51.

Western Regional Climate Center. 2004. Climate of Colorado narrative and state climate data. Available online at http://www.wrcc.dri.edu

Wright, H.A. and A.W. Bailey. 1982. *Fire ecology: United States and southern Canada.* John Wiley and Sons. NY. 501 p.

WESTERN GREAT PLAINS SHORTGRASS PRAIRIE

R. Rondeau



(COMPLEX)
Blacktailed Prairie Dog Town Grassland Complex
ARISTIDA PURPUREA HERBACEOUS ALLIANCE
Aristida purpurea Herbaceous Vegetation
BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE
Bouteloua curtipendula - Bouteloua (eriopoda, gracilis) Herbaceous Vegetation
BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE
Bouteloua eriopoda - Bouteloua gracilis Herbaceous Vegetation
Bouteloua eriopoda - Bouteloua hirsuta Herbaceous Vegetation
BOUTELOUA GRACILIS HERBACEOUS ALLIANCE
Bouteloua gracilis - Bouteloua curtipendula Herbaceous Vegetation
Bouteloua gracilis - Bouteloua hirsuta Herbaceous Vegetation
Bouteloua gracilis - Buchloe dactyloides - Pleuraphis jamesii Herbaceous Vegetation
Bouteloua gracilis - Buchloe dactyloides Herbaceous Vegetation
Bouteloua gracilis - Buchloe dactyloides Xeric Soil Herbaceous Vegetation
Bouteloua gracilis - Pleuraphis jamesii Herbaceous Vegetation
Bouteloua gracilis Herbaceous Vegetation
BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE
Bouteloua hirsuta - Bouteloua curtipendula Herbaceous Vegetation
Bouteloua hirsuta Herbaceous Vegetation [Placeholder]

Overview: This system is found primarily in the western half of the Western Great Plains Division east of the Rocky Mountains and ranges from the Nebraska Panhandle south into Texas and New Mexico, although some examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie.

Characteristic species: In much of its range, this system forms the matrix system with *Bouteloua* spp. dominating this system. Other associated graminoids may include *Buchloe dactyloides, Hesperostipa comata, Koeleria macrantha (= Koeleria cristata), Pascopyrum smithii (= Agropyron smithii), Aristida purpurea* and *Sporobolus cryptandrus*. Although tallgrass and mixedgrass species may be present especially on more mesic soils, they are secondary in importance to the sod-forming short grasses. Shrub species such as *Artemisia filifolia, Artemisia tridentata, and Chrysothamnus spp.* that dominate the Western Great Plains shrubland systems may also be present.

This system in combination with the associated wetland systems represents one of the richest areas, in the United States, for large mammals. Grassland bird species may constitute one of the fastest declining vertebrate populations in North America. A healthy shortgrass prairie system should support viable populations of pronghorn, endemic grassland birds, prairie dog complexes,

and other Great Plains mammals. Historically, such areas would also have been populated by bison in sufficient numbers to support populations of wolves.

Environment: This system occurs primarily on flat to rolling uplands with loamy, ustic soils ranging from sandy to clayey.

Dynamics: Large-scale processes such as climate, fire and grazing influence this system. In contrast to other prairie systems, fire is less important, especially in the western range of this system, because the often dry and xeric climate conditions can decrease the fuel load and thus the relative fire frequency within the system. However, historically, fires that did occur were often very expansive. Currently, fire suppression and certain grazing patterns in the region have likely decreased the fire frequency even more, and it is unlikely that these processes could occur at a natural scale. A large part of the range for this system (especially in the east and near rivers) has been converted to agriculture. Areas of the central and western range have been impacted by the unsuccessful attempts to develop dryland cultivation during the Dust Bowl of the 1930s. The short grasses that dominate this system are extremely drought- and grazing-tolerant. These species evolved with drought and large herbivores and, because of their stature, are relatively resistant to overgrazing.

Variation: This system spans a wide range and thus there can be some differences in the relative dominance of some species from north to south and from east to west.

S. Neid