# Rare Plant Surveys on the Pinon Canyon Maneuver Site 2006-2007

**Colorado Natural Heritage Program**
**Colorado State University**
**8002 Campus Delivery**
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Natural Heritage Program COLORADO

Colorado State University
*Knowledge to Go Places*

**Rare Plant Surveys on the Pinon Canyon Maneuver Site 2006-2007**

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Cover photograph: The Pinon Canyon Maneuver Site, Photo by K. Forrest

## EXECUTIVE SUMMARY

The Colorado Natural Heritage Program (CNHP) performed field surveys and rare plant mapping for four sensitive plant species at the Pinon Canyon Maneuver Site (PCMS): dwarf milkweed (*Asclepias uncialis* ssp. *uncialis*), round-leaf four-o'clock (*Mirabilis rotundifolia*), Arkansas Valley evening primrose (*Oenothera harringtonii*), and rayless goldenweed (*Oonopsis foliosa* var. *monocephala*). These plant species are globally rare but are not listed or candidates for listing under the Endangered Species Act. Proactive management and conservation of these species may help preclude the need for listing. The information provided by mapping locations of rare plant species will facilitate natural resource planning at the installation. It will also inform rare plant protection in southeast Colorado in partnership with several other agencies and organizations.

The PCMS is located in north-central Las Animas County, Colorado, about 25 miles (40 km) southwest of the town of La Junta. Located in the Arkansas Tablelands section of the Great Plains-Palouse Dry Steppe physiographic province, the 235,802 acre site is comprised of pinon-juniper woodlands and short grass prairie. It includes extensive uplands and tributary drainages on the north side of the Purgatoire Canyon, which is the longest and deepest canyon system in eastern Colorado.

Following Natural Heritage methodology, approximately 3,800 acres were surveyed targeting suitable habitat at the southwest end of the PCMS. Eleven new occurrences were found of the target species. Nine element occurrences were updated in 2007, and six were updated in 2006.

The PCMS contains many occurrences of plant Species of Special Concern and DoD Species at Risk, some of which represent the highest quality locations known for these species in the world. Thus the management of these species at the PCMS will be important for the overall rangewide survival of these species. Species for which the PCMS has significant management responsibility and potential for impact include:

- **Dwarf milkweed (*Asclepias uncialis* ssp. *uncialis*)**: the PCMS contains 24 percent of the known occupied acres of dwarf milkweed, and 34 percent of the high quality plant occurrences acreage.
- **Arkansas Valley evening primrose (*Oenothera harringtonii*)**: the PCMS contains 17 percent of the known occupied acres of Arkansas Valley evening primrose, and 49 percent of the high quality plant occurrence acreage.
- **Rayless goldenweed (*Oonopsis foliosa* var. *monocephala*)**: the PCMS contains 80 percent of the known occupied acres of rayless goldenweed, and 86 percent of the high quality plant occurrence acreage.
- **Round-leaf four-o'clock (*Mirabilis rotundifolia*)** the PCMS contains 12 percent of the known occupied acres of round-leaf four-o'clock, and 13 percent of the high quality plant occurrence acreage. The occurrences at the PCMS are significant because they are very high quality and disjunct from the main portion of the species range.

The rare plant mapping that resulted from these field surveys will facilitate natural resource planning at the PCMS and has provided valuable data about these important elements of biodiversity.

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## INTRODUCTION

### Background

In an analysis of rare plant and animals on federal lands, Groves et al. (2000) found that Department of Defense (DoD) lands play a primary role in supporting federally listed and imperiled species in comparison with other major federal agency holdings. Consequently, the proactive management of these at risk species and their habitats on and around DoD installations can help preclude the need for federal listing, reduce recovery costs, and protect significant biological diversity, while enabling the services to continue providing high quality military training (NatureServe 2004). Species at risk on DoD installations were defined by NatureServe (2004) as: (1) plant and animal species that are not yet federally listed as threatened or endangered under the Endangered Species Act, but that are either designated as candidates for listing or are regarded by NatureServe as critically imperiled or imperiled throughout their range AND (2) with populations that are known to occur on or near DoD installations.

In 2006, the Colorado Natural Heritage Program (CNHP) began a two-year rare plant survey and the Piñon Canyon Maneuver Site (PCMS). Similar surveys also occurred at Fort Carson (Neid and Handwerk 2007). These surveys were intended to facilitate natural resource planning at the PCMS by surveying for the target plant species (Table 1). Because the vicinity of the Arkansas River Valley in southeast Colorado has a high concentration of rare plant species (there are 48 species considered to be rare by the Colorado Natural Heritage Program in this region, several of which are endemic to the area), the surveys were also expected to make a significant contribution to what is known about other rare plant species in the area.

**Table 1: Target species for rare plant surveys at PCMS in 2006 and 2007.**
Nomenclature follows PLANTS Database (USDA NRCS 2007) for global scientific name and common name and Weber and Wittman (2001) for state scientific name. See Appendix A for explanation of Natural Heritage Ranking System. Flowering period is from Spackman et al. (1997).

| Global Scientific Name | State Scientific Name | Common Name | Global Rank | State Rank | Flowering Period |
|---|---|---|---|---|---|
| *Asclepias uncialis* ssp. *uncialis* | *Asclepias uncialis* ssp. *uncialis* | dwarf milkweed | G3G4T2T3 | S2 | April-May |
| *Oenothera harringtonii* | *Oenothera harringtonii* | Arkansas Valley evening primrose | G2G3* | S2S3* | mid May-June |
| *Oönopsis foliosa* var. *monocephala* | *Oönopsis foliosa* var. *monocephala* | rayless goldenweed | G3G4T2 | S2 | mid June-July |
| *Mirabilis rotundifolia* | *Oxybaphus rotundifolius* | round-leaf four-o'clock | G2 | S2 | June |

*Recent rank changes that may not be reflected in NatureServe postings.

### Study Area

#### *Regional Setting*

The PCMS is located in north-central Las Animas County, Colorado, nearly 100 miles (160 km) southeast of the city of Colorado Springs, and about 25 miles (40 km)

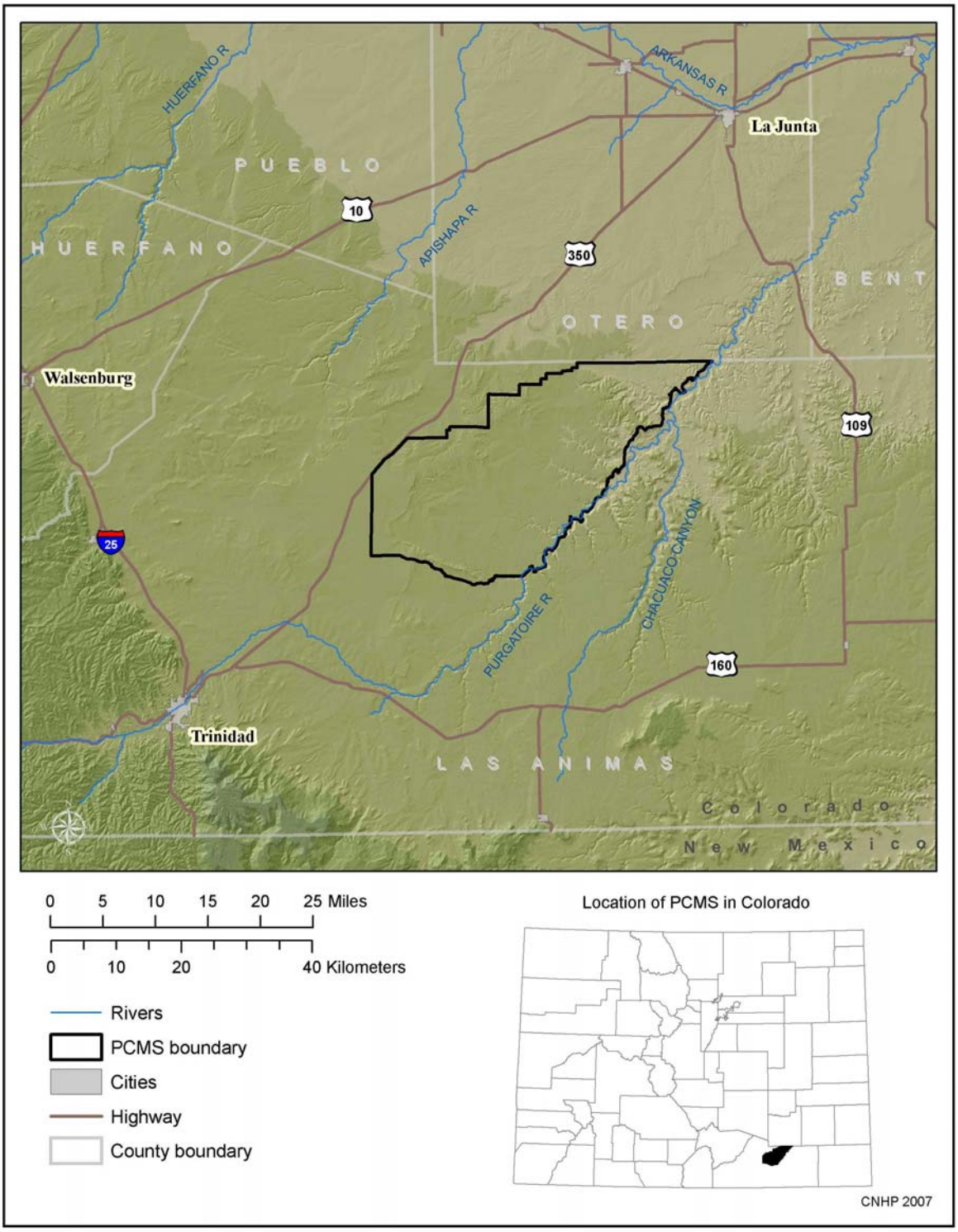



**Figure 1. Vicinity of the Pinon Canyon Maneuver Site in southeastern Colorado.**

southwest of the town of La Junta (Figure 1). The site extends southwest along the north side of the Purgatoire River from the Las Animas county line to a point some 65 air miles upstream of the junction of the Purgatoire with the Arkansas River. Highway 350

between La Junta and Trinidad parallels the northwestern border of the site. Elevations at the site range from about 4,400 feet (1340 m) in the canyon bottom at the northeast boundary to over 5,800 feet (1770 m) on ridge tops near the southwest boundary.

The PCMS is located in the Arkansas Tablelands section of the Great Plains-Palouse Dry Steppe physiographic province (Bailey 2001). The 235,802 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). Away from the river, the northwestern portion of the site is dominated by the high ground of the Big Arroyo Hills, Bear Spring Hills, and Black Hills. From these hills the rolling to flat terrain slopes gently down to the main canyon of the Purgatoire River, which forms the southeastern border of the site. With the exception of the few drainages on the northwestern boundary of the site, all drainage on the PCMS is toward the Purgatoire River. From Van Bremmer Arroyo at the upstream (southern) end, to the headland between Minnie and Whithers canyons at the downstream end, the uplands are dissected by ten intermittently flowing arroyos or canyons that drain into the river. These drainages contain seeps and springs that maintain permanently wet stretches during most years.

The lands south of the Arkansas River, including what is now the PCMS, first became part of the United States of America as a consequence of the Mexican-American War in 1848. Originally part of the Territory of New Mexico, in 1861 the area was incorporated into the newly created Colorado Territory as part of Huerfano County. Las Animas County was separated from Huerfano in 1866, and Colorado achieved statehood ten years later. The vicinity of the PCMS was adjacent to the Mountain Branch of the Santa Fe Trail, which paralleled the Purgatoire River from its junction with the Arkansas south towards Raton Pass (Friedman 1985). With the advent of homesteading in the area, sheep and cattle ranching became the primary economic activity in the area. Although many of the early settlers raised both sheep and cattle on small tracts, this gradually evolved into large-scale cattle ranching on consolidated ranches (Friedman 1985). By the 1980s, there were 13 occupied ranches in the area. In 1982, the U.S. Army acquired the lands comprising the PCMS for brigade-level mechanized military training, bringing all grazing on the tract to an end. Military training did not begin on the site until August 1985.

*Climate*

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 the 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 2007). 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.

*Geology*

In the vicinity of the PCMS, the Arkansas River and its tributaries have excavated much of the Tertiary piedmont deposits and exposed Cretaceous marine rocks from Cañon City to the Kansas and New Mexico borders (Trimble 1980). Geology of the PCMS area (Figure 2) has been mapped at a scale of 1:250,000 by Scott (1968) and Johnson (1969). The upper canyon walls of the Purgatoire and its tributary canyons in this stretch are formed in the oldest of the Cretaceous layers present in the area: the Lytle and Glencairn members of the Purgatoirie Formation, topped by Dakota sandstone. These layers sit uncomformably on the uppermost Jurrasic formation of the area (the Morrison) in which the extensive Picketwire Canyonlands dinosaur trackway is exposed on adjacent USDA Forest Service lands. As one moves away from the river, younger Cretaceous layers of the Carlile Shale, Greenhorn Limestone and Graneros Shale form the broad middle expanse of the site. These in turn are overlain to the northwest by breaks and hills of gray shale and limestone belonging to the Niobrara Formation. Adjacent to Van Bremmer Arroyo on the southern edge of the site, a prominent hogback is formed by intrusive basalt of Tertiary age.

*Soils*

The soils at the PCMS belong predominantly to two soil orders, Entisols and Aridisols (Shaw et al. 1989). Entisols are soils that show little or no evidence of diagnostic horizons; these are typically young soils either on actively eroding slopes or on flood plains where alluvium is frequently deposited. Entisols at the PCMS include two great groups, the Torriorthents (2 soil types) and the Torrifluents (sixteen soil types). Aridisols are soils of very dry areas with limited availability of soil moisture for sustained plant growth. Soils at the PCMS include four great groups within the Aridisols: Haplargids (eleven soil types, including some overlap with the Torriorthents), and Camborthids, Natrargids, and Calciorthids (each with a single soil type represented).

*Vegetation*

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 communities, such as ponderosa pine (*Pinus ponderosa*) woodland, aspen (*Populus tremuloides*) woodland, and plains greasebush (*Glossopetalon planitierum*) shrubland, are also present. 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.

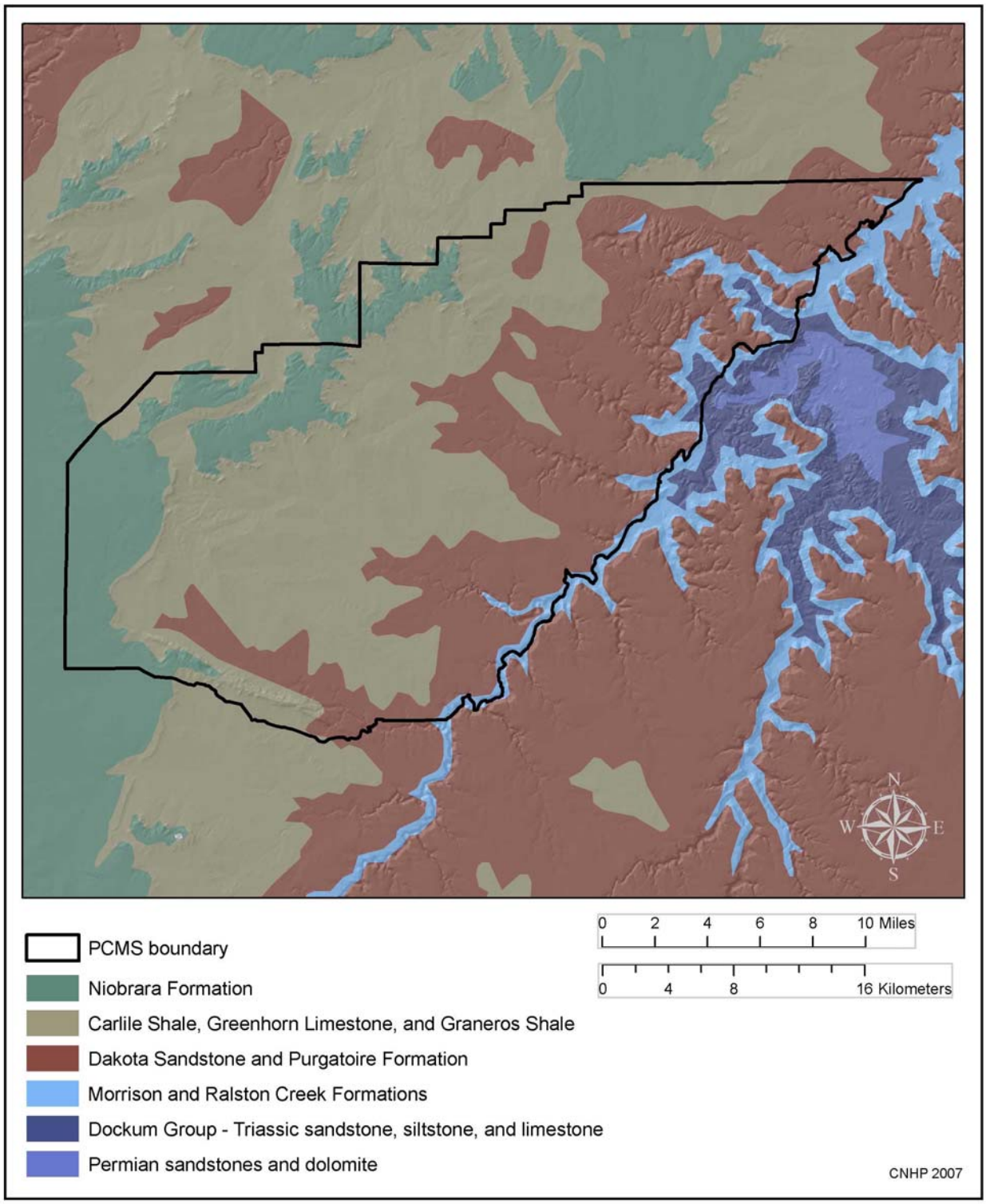



**Figure 2. Geology of the Pinon Canyon Maneuver Site.**

## METHODS

CNHP staff performed field surveys in targeted inventory areas at the PCMS during the field seasons of 2006 and 2007. Surveys were scheduled to coincide with the flowering periods of target species (see Table 1). Occurrences previously documented from the PCMS were revisited and updated, and additional habitat searched (Figure 3). Targeted inventory areas included the vicinity of previously documented occurrences, as well as other apparently suitable habitat as identified through the use of aerial photographs, topographic maps, and geologic maps. Habitat characterized as juniper breaks was the primary focus of survey efforts. Additional habitat types likely to support target species (e.g. rock outcrops, sand washes, roadsides), were also searched.

Target species occurrences were documented with standard Natural Heritage Methodology (NatureServe 2006, Appendix A). Data collected using this methodology includes location information, plant population parameters, and habitat characteristics. Location data were collected as GPS coordinates or depicted on topographic maps or aerial photos from which a legal description (township, range, and section) can be determined. Data collected on plant populations included occurrence size and condition. Abundance was determined by censusing the occurrence or by estimating the number of individuals if the population was large. Size of the area covered by the population was also estimated or calculated using GIS. Condition of plant populations was assessed by data collected on phenology (percent of the plants that are vegetative, percent in flower, and percent in fruit at the time of survey); reproductive success (evidence of seed dispersal and establishment); age class structure; symbiotic or parasitic relationships (e.g. pollinators present); and evidence of disease, predation or injury. Habitat data included descriptions of the surrounding landscape, dominant plant community or associated plant species, elevation, topographic position, slope, shape of slope, aspect, light exposure, soil texture, moisture gradient, and geomorphic landform.

In addition to data characterizing the species population and its habitat, information that is intended to evaluate the conservation status of each occurrence (i.e. the likelihood of continued existence of the plant population at the location as well as means of increasing its viability and recoverability) was collected. The quality of each occurrence is ranked according to a system that incorporates size, condition/quality, and landscape context. This information can assist with management of the areas by identifying threats and natural or unnatural disturbance (e.g. effects on population viability due to exotic species). Existing protection plans or strategies for the species or for a location were also referenced. Herbarium voucher specimens for new occurrences were collected and deposited in Colorado herbaria when the population size was sufficient to support collecting. Where population size was insufficient, photographs of diagnostic characters were taken. Field survey results were entered into the CNHP Biotics database.

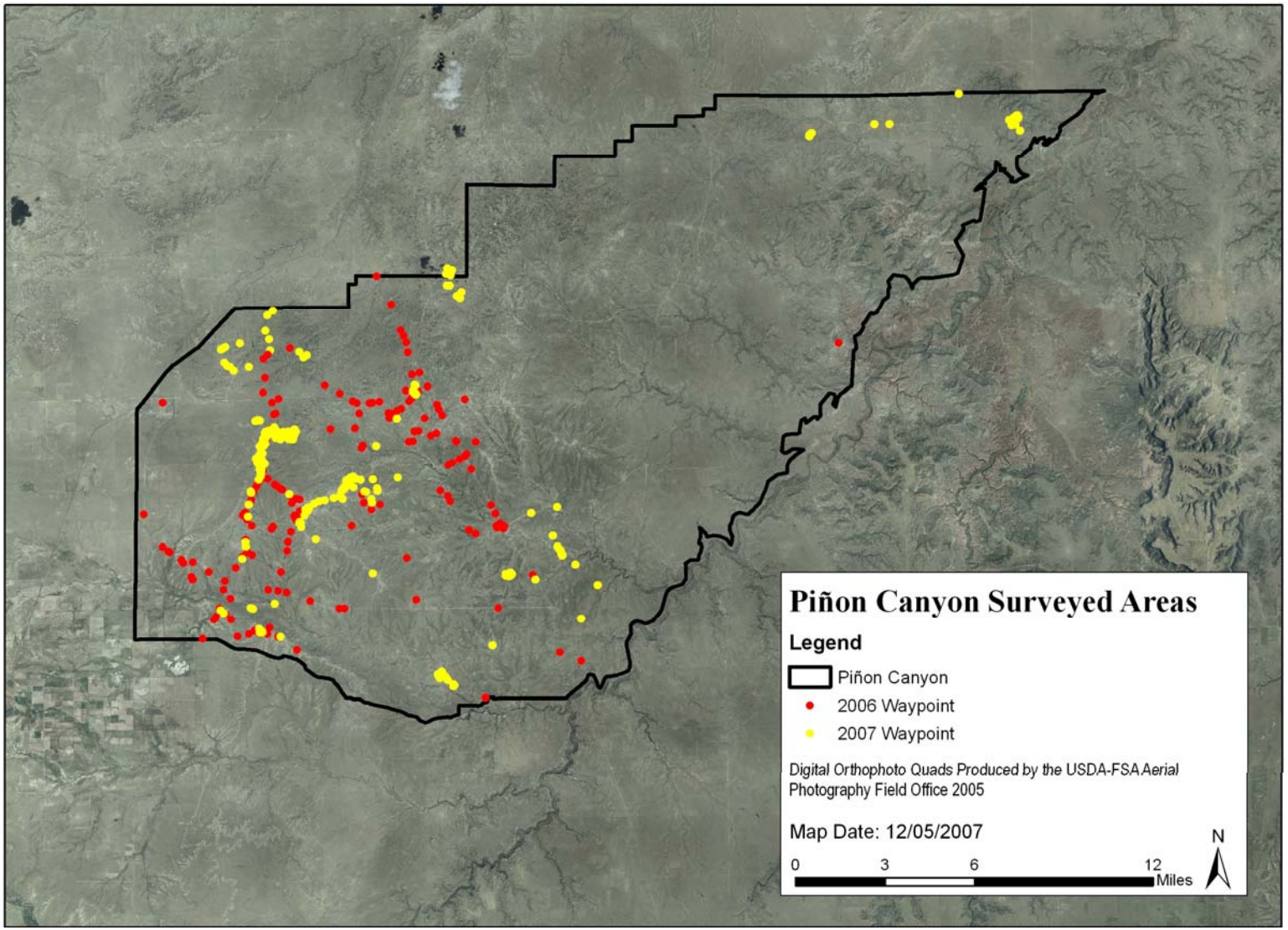



**Figure 3. Areas surveyed at the PCMS, 2006 & 2007.**

## RESULTS AND DISCUSSION

Area surveyed at the PCMS in 2006 and 2007 is shown in Figure 3. Approximately 685 acres were surveyed in 2006 and approximately 3800 in 2007. The majority of survey work occurred in the western half of the PCMS with some additional survey effort in the northeast corner.

Element Occurrences

New locations were found for all of the target species and most of the previously known element occurrence record locations were evaluated. In addition to the target species, new occurrences of plains greasebush (*Glossopetalon (=Forsellesia) planitierum*; G4/S1) were discovered on the PCMS incidentally during the surveys. However, this species was not systematically searched for and mapped on the PCMS. There are numerous other rare species known from the PCMS area that would benefit from a targeted inventory effort (CNHP 2007).

A total of 11 new element occurrence records were found for the four target species on PCMS (Table 2). In addition, six occurrences were updated in 2006 and nine were updated in 2007.

Acreage of element occurrences for the target species at PCMS following the 2006-2007 field surveys are listed in Table 3. Geographic range in Colorado was determined by calculating the area of a minimum convex polygon around all mapped occurrences for the species in the CNHP Biotics database (CNHP 2007). Total rangewide acres and occupied acres were calculated from all element occurrence records for the species in the CNHP Biotics database with precise location information. Percent of high quality (A- and B-ranked) occurrences was calculated from the total acreage of all high quality occurrences in Colorado.

The target species mapped on the PCMS comprise a total of 1,148acres. The PCMS contains a significant portion of the total rangewide acreage of dwarf milkweed (*Asclepias uncialis* ssp. *uncialis*) and rayless goldenweed (*Oonopsis foliosa* var. *monocephala*). It also contains a significant percentage of high quality occurrences for these species as well as for Arkansas Valley evening primrose (*Oenothera harringtonii*; Table 3). Two of the occurrences of rayless goldenweed on PCMS have excellent viability (A rank). For round leaf four-o'clock (*Mirabilis rotundifolius*), although the total acreage and percentage of high quality occurrence acreage found on PCMS is relatively low, these occurrences are significant because they are estimated to have excellent viability and they are widely disjunct from the main part of the species range.

**Table 2. Element occurrence (EO) records at PCMS.**
See Appendix A for explanation of Natural Heritage Ranking System.

| Species | EO Number | EO Rank | Notes |
|---|---|---|---|
| *Asclepias uncialis* ssp. *uncialis* | 24 | A | Size and condition updated and new locations mapped. |
| | 26 | A | Size and condition updated. Location of rare moth (*Pygarctia neomexicana*) documented. |
| | 28 | A | Size and condition updated. |
| | 37 | E | Last observed in 1997. |
| | 38 | B | Size and condition updated and new locations mapped. |
| | 40 | B | New record |
| *Mirabilis rotundifolia* | 24 | A | Size and condition updated and new locations mapped. |
| | 44 | A | New record in 2006; size and condition updated in 2007. |
| *Oenothera harringtonii* | 19 | B | Size and condition updated and new locations mapped. |
| | 35 | A | Size and condition updated and new locations mapped. |
| | 50 | A | New record |
| | 51 | E | New record |
| | 52 | C | New record |
| | 53 | B | New record |
| | 54 | E | New record |
| | 55 | E | New record |
| | 56 | D | New record |
| *Oonopsis foliosa* var. *monocephala* | 2 | B | New record |
| | 12 | A | Size and condition updated and new locations mapped. |
| | 26 | B | New record in 2006. New locations mapped in 2007. |

**Table 3. Summary information on the range, occupied habitat, and occurrence quality for the target species and their occurrences at PCMS.**

| Plant species | Geographic range in Colorado (sq mi) | Total acres known in Colorado | Occupied acres on PCMS | Percent of total Colorado acreage occurring on PCMS | Percent of high quality (A- and B-ranked) occurrences on PCMS |
|---|---|---|---|---|---|
| *Asclepias uncialis* ssp. *uncialis* | 27,785 | 406 | 96 | 23.6 | 33.6 |
| *Mirabilis rotundifolia* | 1441 | 2636 | 327 | 12.4 | 13.4 |
| *Oenothera harringtonii* | 6059 | 2146 | 361 | 16.8 | 49.2 |
| *Oonopsis foliosa* var. *monocephala* | unknown | 458 | 364 | 79.5 | 85.9 |

Target Species Accounts

**Dwarf milkweed (*Asclepias uncialis* ssp. *uncialis*); Milkweed Family (Asclepiadaceae)**

The PCMS is regarded as the exemplary location for this diminutive milkweed (CNHP 2007). Six of the approximately 35 known occurrences of this species (in fourteen counties) in Colorado are found on the maneuver site, including three of the four highest quality known occurrences occupying 24 percent of the known acreage of dwarf milkweed in Colorado. Currently, dwarf milkweed is found in small occurrences throughout most of its range. Documented occurrences are largest on the PCMS and in the area around Pueblo Reservoir in Pueblo County, Colorado. Because this species is apparently not collected as frequently as it was some 100 to 150 years ago, and has not been relocated at many historically known occurrences, it is often presumed to be declining (Locklear 1996). Due to its unusually early blooming period, however, this species may also be under-documented.

Dwarf milkweed is most commonly associated with grass species typical of shortgrass prairie, and plants are usually found growing in open spaces between grass clumps. Forbs, shrubs, and trees typically comprise less than 15 percent of the total vegetation cover (Locklear 1996), although populations may be found at the interface of grassland with juniper savanna and juniper breaks habitat. Plants also occur at toeslopes of bluffs, on slope crests, and in somewhat featureless open grassland habitat. At the PCMS the species occurs in grassland habitat dominated by blue grama (*Bouteloua gracilis*) and New Mexico feathergrass (*Hesperostipa neomexicana*) or in juniper (*Juniperus monosperma*) savanna on gentle slopes or on flat benches. Although its geographic range within Colorado includes most of the eastern plains, the actual area occupied by occurrences is very small.

Threats to dwarf milkweed include effects of population limitation by unknown biological requirements, altered disturbance regime, habitat loss, and habitat degradation (Decker 2006). At the PCMS, altered disturbance regime and habitat degradation or loss are likely to be the most pertinent threats. Although little is known about the life history of dwarf milkweed, a rare moth (*Pygarctia neomexicana*; G3) was found laying its eggs on a tussock of dwarf milkweed in 2007. This is the first record of this moth in Colorado (Opler pers comm.). The lack of sufficient life history information makes it difficult to make conservation and management strategies for the species. Information on demographics, pollination ecology, and response to disturbance (both natural and anthropogenic) would inform management recommendations. Given the lack of information, a conservative strategy for defining appropriate management practices would include activities that maintain intact native habitat (free of exotic species, predominated by natural ecological processes) in and around occurrences. For occurrences at the savanna-grassland ecotone, successional status of adjacent woodland habitat may be important and maintaining a natural disturbance regime would be beneficial to known occurrences. Plants appear to tolerate infrequent vehicle use, such as two-tracks, or occasional passes by tanks; however, younger or smaller individuals may be killed by such disturbance (Decker 2006). The species, however, is not found in

habitats that have been subject to more severe disturbance such as cultivation, grading, excavating, etc. Proactive weed management that prevents invasion of known occupied areas is preferable to weed treatment within occurrences as dwarf milkweed itself is susceptible to herbicide spraying and it is likely the rare moth seen on dwarf milkweed at the PCMS is not resistant to it as well.

Primary management recommendations for dwarf milkweed at the PCMS include continuing inventory efforts and establishing population monitoring. Due to its diminutive size and relatively brief appearance during the growing season, it is somewhat difficult to detect; proper training in identification of dwarf milkweed and careful survey attention to its phenology will be the most beneficial in targeting inventory efforts. Monitoring the occurrences at the PCMS will contribute to our understanding of whether the species is truly in decline or whether current population demographics are within its historical range of variability. CNHP element occurrence record information would provide baseline data for analyzing trends and informing management.

**Round-leaf four-o'clock (*Mirabilis rotundifolia*); Four-o'clock Family (Nyctaginaceae)**

Round-leaf four-o'clock is a narrowly endemic species occurring primarily between Canon City, Fort Carson, and Pueblo, but with two disjunct occurrences in Las Animas County at the PCMS. It is currently known from approximately 30 distinct locations in the world within a relatively small, 1440 square mile geographic range, within which it only occupies approximately 2,636 acres, 327 of which are on the PCMS (Table 3). The species is restricted to shale barren habitat between 4,800-5,600 feet and is primarily found on the Smoky Hill shale member of the Niobrara Formation although there are several occurrences noted from Carlile and Pierre shales (CNHP 2007). At the PCMS round-leaf four-o'clock is found on outcrops of Niobrara Formation. Throughout its range round-leaf four-o'clock exhibits a wide range of population sizes, from fewer than ten plants to several thousand stems, but most commonly occurring with several hundreds of individuals. Occurrences at the PCMS consist of five hundred to several thousands of plants each. These two occurrences both have excellent estimated viability.

Among shale barrens species, round-leaf four o'clock is relatively more susceptible to severe disturbance like road building, mining, or motorcycle traffic (Kelso et al. 1999, CNHP 2007). It does not tend to occur on road cuts although is known from areas adjacent to roads that were not impacted by their construction. It is able to tolerate and actually increases in total stem number under a moderate level of disturbance like limited foot traffic (Kelso et al. 1999). Pesticide use in the vicinity of the occurrences may impact both individual plants and their pollinators (Spackman Panjabi 2004).

**Arkansas Valley evening primrose (*Oenothera harringtonii*); Evening Primrose Family (Onagraceae)**

The Arkansas Valley evening primrose is endemic to south-central Colorado and is known from around 50 occurrences in six counties (CNHP 2007). The geographic range within Colorado covers approximately 6,000 square miles, but populations are unevenly

distributed within this total area, occupying about 2,150 acres. At the PCMS, the species is documented in nine element occurrences mapped over 361 acres (Tables 2 and 3). Two of these occurrences are high quality, which highlights that PCMS contains 49.2 percent of all known high quality occurrences of Arkansas Valley evening primrose. The species is an insect-pollinated annual or biennial herb with a thick taproot and is a prolific seed producer as is typical of plants with short annual or biennial life cycles. (Ladyman 2005). Its flowers open in the evening and are pollinated by sphinx moths (Spackman Panjabi 2004). Populations are highly responsive to annual precipitation; previously known population sizes ranging from less than ten to hundreds of individuals are exhibiting two to four times as many plants in 2007 following high moisture in the late 2006 season and winter 2006-2007 (CNHP 2007).

Arkansas Valley evening primrose is generally found in compacted, silty clay soils derived from shale bedrock, including Niobrara, Carlile, and Pierre shales. At the PCMS it occurs associated with both Niobrara and Carlile shales. Arkansas Valley evening primrose tends to occur at toeslopes and on flats in landscape swales, but it does colonize slopes that can be somewhat steep. The species also tends to spill out onto roadcuts adjacent to occupied shale barrens, opportunistically colonizing the disturbed habitat. It tends to occur in relatively high numbers along roadsides. These sorts of habitats imply that Arkansas Valley evening primrose is adapted to some mild degree of small-scale disturbance like processes of deposition and of shrink-swell cycles in clay soils more so than larger scale, more intensive disturbance. Threats to Arkansas Valley evening primrose include any threats to the shale barrens habitat, but at the PCMS especially invasion by exotic species and right-of-way maintenance.

There are nine documented occurrences of Arkansas Valley evening primrose at the PCMS, including one occurrence of perhaps 500 individuals. Other populations are believed to be smaller. The complete extent of the PCMS populations of this somewhat ephemeral species has not been fully documented.

**Rayless goldenweed (*Oönopsis foliosa* var. *monocephala*); Sunflower family (Asteraceae)**

This clonal subshrub member of the sunflower family is endemic to Las Animas County, Colorado, where it is predominantly found in sparsely vegetated areas within the shortgrass prairie. Rayless goldenweed is known to occupy 458 acres, eighty percent of which are on the PCMS. Occurrences are typically on or near shale and clay slopes, including disturbed or eroded areas such as gullies, and toeslopes, rather than open plains (Shaw and Schulz 1992). It also occurs in two-tracks and other corridors. Soils are typically dry, fine-grained and clayey.

There are ten known extant occurrences of rayless goldenrod, three of which are on the PCMS. These include the highest quality occurrence known for the species, as well as two of the four known occurrences with good estimated viability. At the PMCS, occurrences of rayless goldenweed are concentrated in the southwestern portion of the site, especially in the Taylor and Van Bremmer Arroyo watersheds. Similar habitat in the

vicinity of the PCMS is likely to support additional occurrences of this species, but many areas have not yet been thoroughly searched.

Shaw and Schulz (1992) suggested that disturbance may play an important role in the population dynamics of this species. Moreover, because the species reproduces both sexually and by rhizomes, it may be more tolerant of disturbance. Although the species seems to tolerate a moderate level of disturbance, more information is needed on the effects of both natural and anthropogenic disturbance to evaluate its role in the species' life history. Current levels of disturbance appear to be tolerated by known populations, however, management objectives should be based on the results of long-term population monitoring.

Potential Conservation Areas

As a result of this survey, CNHP has identified three Potential Conservation Areas (PCAs) at the PCMS that are significance for the target species (Figure 4). Two of the PCAs in the southwestern portion of the site have very high biodiversity significance, and one in the northeastern portion has high significance (see Appendix A for explanation of PCA ranking).

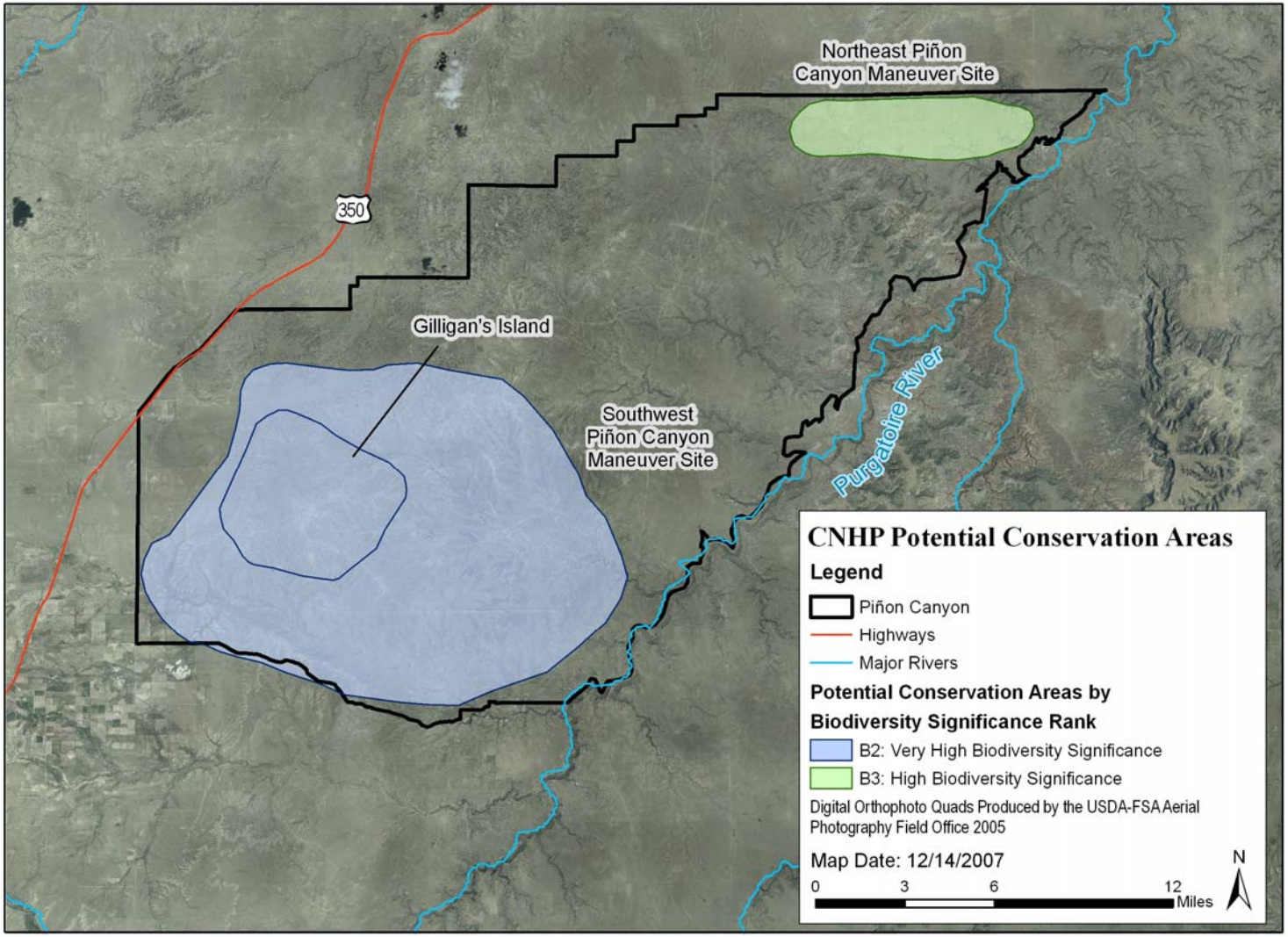



**Figure 4. Potential Conservation Areas at the PCMS**

# Gilligan's Island

**Biodiversity Rank - B2: Very High Biodiversity Significance**

**Protection Urgency Rank - P2: Threat/Opportunity within 5 Years**

**Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss**

**U.S.G.S. 7.5-minute quadrangles:** Brown Sheep Camp

**Size:** 15,635 acres (6,327 ha) **Elevation:** 5,235 - 5,915 ft. (1,596 - 1,803 m)

**General Description:** The Gilligan's Island site includes a mix of shortgrass prairie, pinon - juniper woodlands, and sparsely vegetated outcrops of Greenhorn limestone. Steep colluvial sideslopes of mesas and hills reveal limestone outcrops and support concentrations of the globally imperiled plant species, *Oxybaphus rotundifolius.* Other plant species found at this site include *Juniperus monosperma*, *Forsellesia planiterum, Frankenia jamesii, Achnatherum hymenoides, Tetraneuris acaulis, Bouteloua curtipendula, Hesperostipa neomexicana, Eriogonoum* sp., *Penstemon auriberbis, Asclepia asperula, Yucca glauca, Paronychia* sp., *Artemisia bigelovii*, *Gutierrezia sarothrae*, *Paronychia jamesii*, *Eriogonum* sp., *Hiilaria jamesii, Atriplex canescens*, and *Krascheninnikovia lanata.*

**Biodiversity Significance Rank Comments (B2):** This site supports two excellent (A-ranked) occurrences of the globally imperiled (G2/S2) round-leaf four-o'clock (*Oxybaphus rotundifolius*). These occurrences are also significant because they are disjunct from the main part of the species' range.

Natural Heritage element occurrences at the Gilligan's Island PCA.

| Major Group | State Scientific Name | State Common Name | Global Rank | State Rank | Federal Status | State Status | Fed Sens | EO Rank | Last Obs Date |
|---|---|---|---|---|---|---|---|---|---|
| Vascular Plants | Oxybaphus rotundifolius | round - leaf four - o'clock | G2 | S2 | | | | A | 2007-06-29 |
| Vascular Plants | Oxybaphus rotundifolius | round - leaf four - o'clock | G2 | S2 | | | | A | 2007-06-30 |

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

**Boundary Justification:** The boundary is drawn to include the element occurrences and additional potential habitat, as well as some representation of the locally adjacent plant communities.

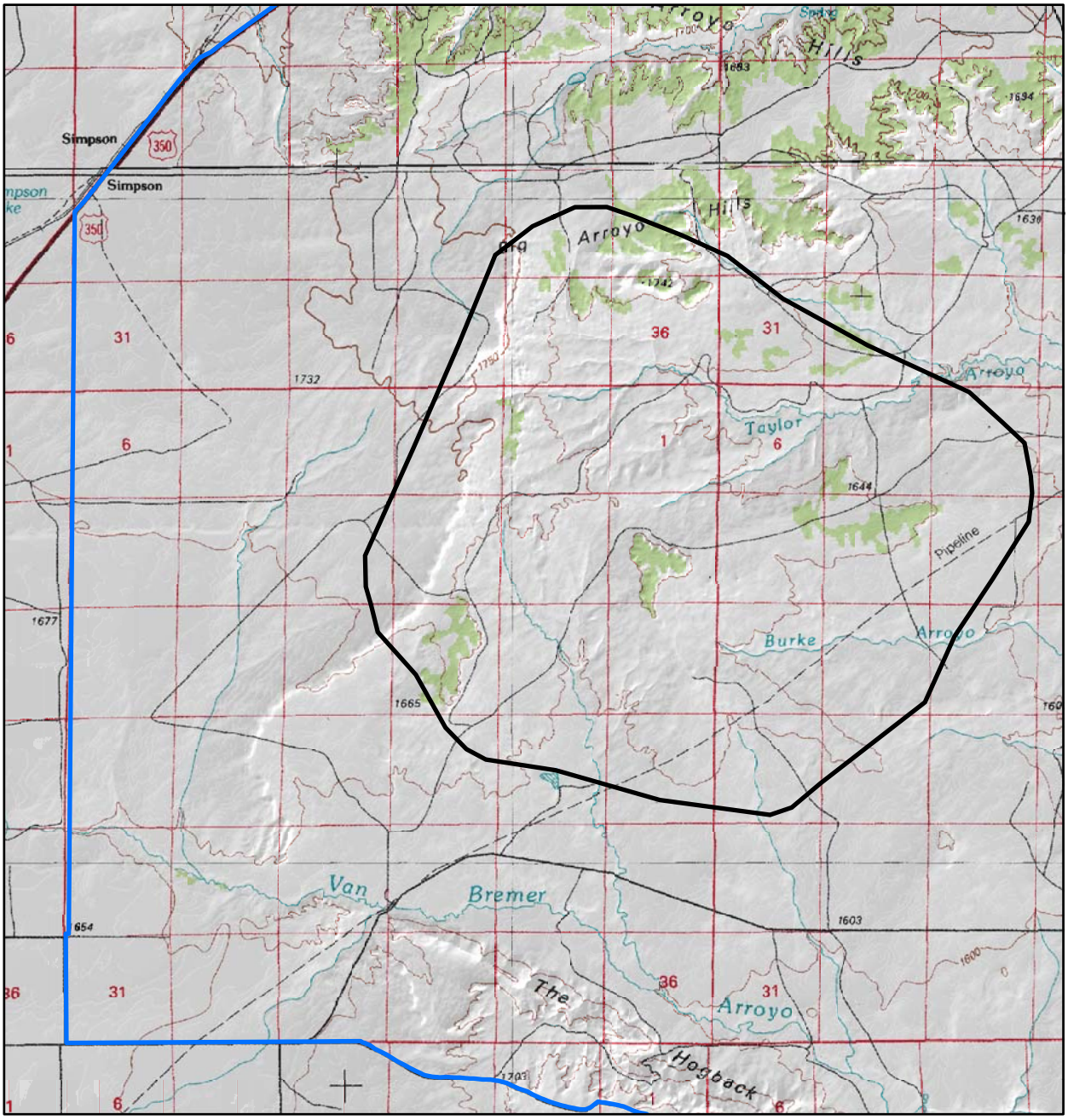
**Protection Urgency Rank Comments (P2):** This site is located on U.S. Department of Defense lands in the Pinon Canyon Maneuver Site (PCMS). The area is used by the military for training purposes, which could have a negative impact on the native vegetation depending on the rigorousness and extent of the training activities. In

2006 tank tracks were noted within the occurrences of the globally imperiled plants. Natural resource personnel at PCMS are aware of the sensitive plant locations. However, the natural resource personnel do not have the authority to direct the training exercises.

**Management Urgency Rank Comments (M2):** The area shows some signs of degradation from tank maneuvers, but is still in relatively good condition. No noxious weeds were noted, however, sixteen noxious weeds are known from the Pinon Canyon Maneuver Site (Spackman Panjabi and Decker 2007) and have the potential to infest areas within the Gilligan's Island site, especially in areas with periodic ground disturbances. Natural resource personnel at PCMS are aware of the sensitive plant locations, and are actively managing noxious weeds.

**Version Author:** Spackman Panjabi, S.C.

**Version Date:** 12/10/2007

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## Legend

PCA Boundary

PCMS Boundary

Trinidad, 37104-A1

30 x 60 Minute Digital Raster Graphic produced by the U.S. Geological Survey

Location in Piñon Canyon Maneuver Site

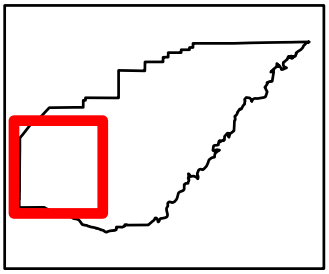

**Figure 5. Gilligan's Island Potential Conservation Area, B2: Very High Biodiversity Significance**

## Southwest Pinon Canyon Maneuver Site

**Biodiversity Rank - B2: Very High Biodiversity Significance**

**Protection Urgency Rank - P2: Threat/Opportunity within 5 Years**

**Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss**

**U.S.G.S. 7.5-minute quadrangles:** Brown Sheep Camp, Doss Canyon North, Lambing Spring, Lockwood Arroyo, Painted Canyon, Rock Crossing, Thatcher, Tyrone

**Size:** 87,465 acres (35,396 ha) **Elevation:** 4,775 - 5,915 ft. (1,455 - 1,803 m)

**General Description:** This area is characterized by low hills, mesas, sandstone outcrops, and canyons. Dominant vegetation types include shortgrass prairie and scattered juniper woodlands (*Juniperus monosperma*). The prairie is in good to excellent condition despite military tank traffic. The grassland is diverse with several grass species including *Bouteloua gracilis, Aristida purpurea, Stipa neomexicana, Muhlenbergia toreyi*, and *Hilaria jamesii*, as well as many other flowering herbs.

**Land Use History:** Area was grazed until 1983.

**Biodiversity Significance Rank Comments (B2):** This site supports three occurrences of the globally imperiled rayless goldenweed (*Oonopsis foliosa* var. *monocephala,* G3G4T2/S2). These are the best known locations for this taxon in the world. The site also supports three excellent (A-ranked) occurrences of a globally vulnerable (G3G4T2T3/S2) plant subspecies, dwarf milkweed (*Asclepias uncialis* ssp. *uncialis*). There are few known excellent occurrences of this species in Colorado. Additionally, the site supports seven occurrences of the globally vulnerable (G2G3/S2S3) Arkansas Valley evening primrose (*Oenothera harringtonii*). One of these occurrences is in excellent (A-ranked) condition and two are in good (B-ranked) condition.

Natural Heritage element occurrences at the Southwest Pinon Canyon Maneuver Site PCA.

| Major Group | State Scientific Name | State Common Name | Global Rank | State Rank | Federal Status | State Status | Fed Sens | EO Rank | Last Obs Date |
|---|---|---|---|---|---|---|---|---|---|
| Vascular Plants | Oenothera harringtonii | Arkansas Valley evening primrose | G2G3 | S2S3 | | | USFS | A | 2007-05-18 |
| Vascular Plants | Oenothera harringtonii | Arkansas Valley evening primrose | G2G3 | S2S3 | | | USFS | A | 2007-06-30 |
| Vascular Plants | Oenothera harringtonii | Arkansas Valley evening primrose | G2G3 | S2S3 | | | USFS | B | 2007-06-29 |
| Vascular Plants | Oenothera harringtonii | Arkansas Valley evening primrose | G2G3 | S2S3 | | | USFS | D | 2007-05-18 |
| Vascular Plants | Oenothera harringtonii | Arkansas Valley evening primrose | G2G3 | S2S3 | | | USFS | E | 2007-05-19 |
| Vascular Plants | Oonopsis foliosa var. monocephala | rayless goldenweed | G3G4T2 | S2 | | | | A | 2006-06-30 |
| Vascular Plants | Oonopsis foliosa var. monocephala | rayless goldenweed | G3G4T2 | S2 | | | | B | 2006-06-29 |
| Vascular Plants | Oonopsis foliosa var. monocephala | rayless goldenweed | G3G4T2 | S2 | | | | B | 2007-06-29 |
| Vascular Plants | Asclepias uncialis ssp. uncialis | dwarf milkweed | G3G4T2T3 | S2 | | | BLM/USFS | A | 2007-05-18 |
| Vascular Plants | Asclepias uncialis ssp. uncialis | dwarf milkweed | G3G4T2T3 | S2 | | | BLM/USFS | A | 2007-05-19 |
| Vascular Plants | Asclepias uncialis ssp. uncialis | dwarf milkweed | G3G4T2T3 | S2 | | | BLM/USFS | A | 2007-05-20 |

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

**Boundary Justification:** The boundary is drawn to include the known occurrences of *Oonopsis foliosa* var. *monocephala, Asclepias uncialis* ssp. *uncialis,* and *Oenothera harringtonii* in this area, and to provide additional potential habitat where individuals can become established over time. Boundary also includes examples of the mosaic of plant communities in this area.

**Protection Urgency Rank Comments (P2):** The site is contained in the Pinon Canon Maneuver Site. Future plans are unknown. At present, it is used as a military training ground.

**Management Urgency Rank Comments (M2):** The area shows some signs of degradation from tank maneuvers, but is still in relatively good condition. Although there are a few patches of exotic plants, no state-listed noxious weeds were noted. However, sixteen noxious weeds are known from the Pinon Canyon Maneuver Site (Spackman Panjabi and Decker 2007) and have the potential to infest areas within the site, especially in areas with periodic ground disturbances. Protection from military maneuvers, including indirect impacts such as the generation of dust, would benefit the occurrences.

**Land Use Comments:** This site is currently a U.S. Army training area. Twice a year for 21 days about 1,500 tanks and other vehicles practice military activities here. A small fence exclosure was erected in 1995 to keep traffic off of a portion of one of the occurrences of *Asclepias uncialis* ssp. *uncialis*. The exclosure is about 1/2 acre or less.

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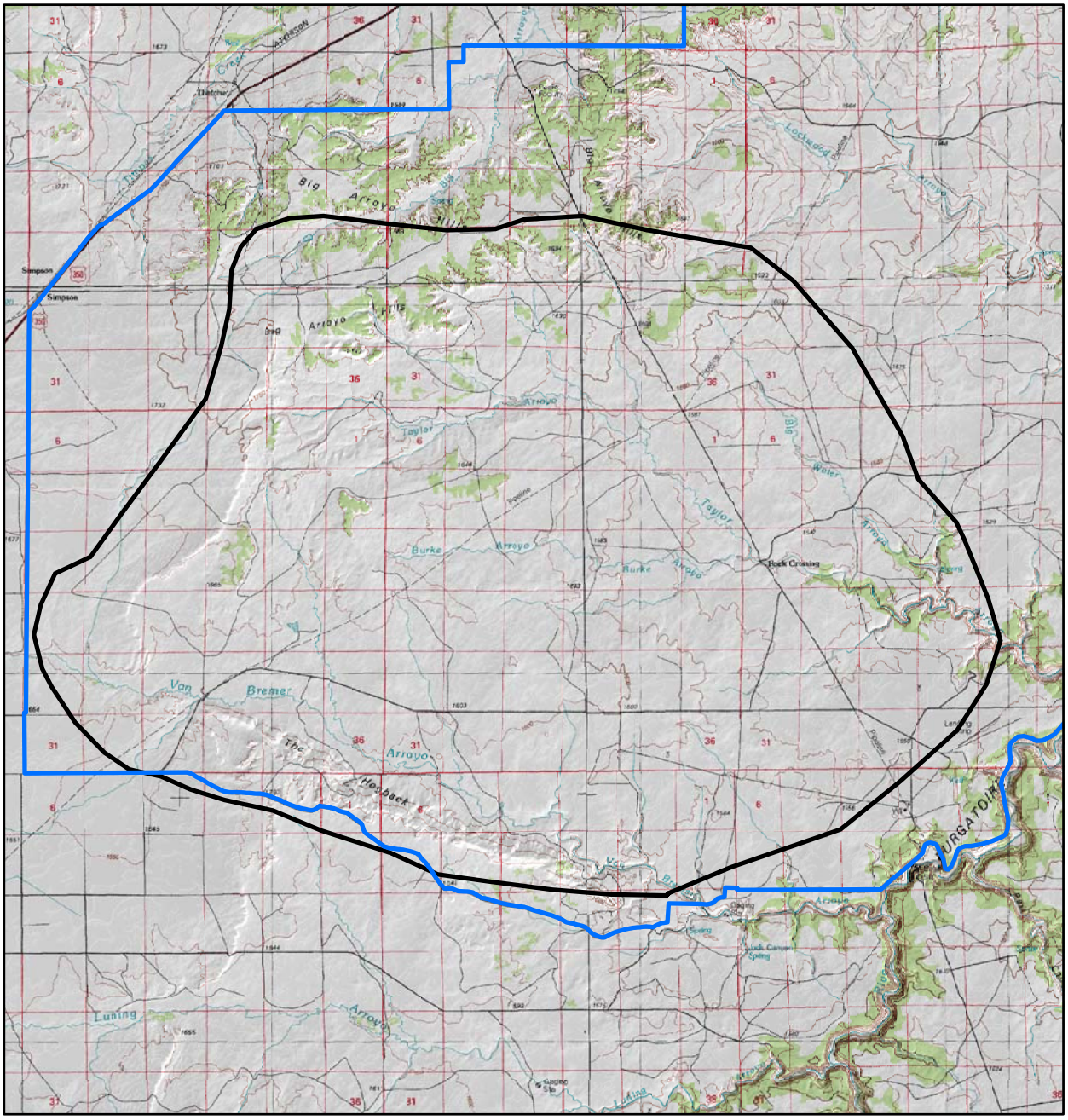
**Version Date:** 12/12/2007

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**Legend**

PCA Boundary

PCMS Boundary

Kim, 37103-A1
La Junta, 37103-E1
Trinidad, 37104-A1
Walsenburg, 37104-E1

30 x 60 Minute Digital Raster Graphics produced by the U.S. Geological Survey

Location in Piñon Canyon Maneuver Site

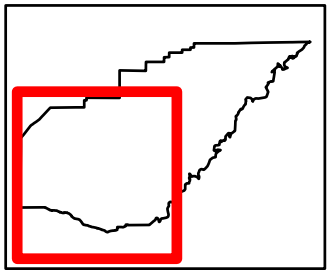

**Figure 6. Southwest Piñon Canyon Maneuver Site Potential Conservation Area, B2: Very High Biodiversity Significance**

## Northeast Pinon Canyon Maneuver Site

**Biodiversity Rank - B3: High Biodiversity Significance**

**Protection Urgency Rank - P2: Threat/Opportunity within 5 Years**

**Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss**

**Size:** 9,345 acres (3,782 ha) **Elevation:** 4,470 - 5,175 ft. (1,362 - 1,577 m)

**General Description:** This site is characterized by open grasslands dissected by juniper woodlands, mesas, and canyons. Dominant plants include *Hesperostipa* sp., *Bouteloua gracilis, Hilaria jamesii,* and *Juniperus monosperma*. Parts of the surrounding area are strongly dominated by *Bromus tectorum* with scattered *Opuntia imbricata, O. polyacantha*, *Gutierrezia sarothrae, Tetraneuris acaulis*, *Buchloe dactyloides, Yucca glauca,* and *Bouteloua curtipendula*.

**Biodiversity Significance Rank Comments (B3):** This site contains two good (B-ranked) occurrences of the globally imperiled dwarf milkweed (*Asclepias uncialis* ssp. *uncialis,* G3G4T2T3/S2). There are few good to excellent (A-B ranked) examples of this subspecies known from Colorado. The globally vulnerable Arkansas Valley evening primrose (*Oenothera harringtonii,* G2G3/S2S3) has also been documented in this area.

Natural Heritage element occurrences at the Northeast Pinon Canyon Maneuver Site PCA.

| Major Group | State Scientific Name | State Common Name | Global Rank | State Rank | Federal Status | State Status | Fed Sens | EO Rank | Last Obs Date |
|---|---|---|---|---|---|---|---|---|---|
| Vascular Plants | Oenothera harringtonii | Arkansas Valley evening primrose | G2G3 | S2S3 | | | USFS | E | 2007-05-20 |
| Vascular Plants | Asclepias uncialis ssp. uncialis | dwarf milkweed | G3G4T2T3 | S2 | | | BLM/ USFS | B | 2007-05-20 |
| Vascular Plants | Asclepias uncialis ssp. uncialis | dwarf milkweed | G3G4T2T3 | S2 | | | BLM/ USFS | B | 2007-05-21 |

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

**Boundary Justification:** This site includes occurrences of *Asclepias uncialis* ssp. *uncialis* and *Oenothera harringtonii*, adjacent potential habitat, and some representation of the local mosaic of plant communities.

**Protection Urgency Rank Comments (P2):** This site is located within U.S.

Department of Defense lands in the Pinon Canyon Maneuver Site (PCMS). The area is used by the military for training purposes, which could have a negative impact on the native vegetation depending on the rigorousness and extent of the training activities. Natural resource personnel at PCMS are aware of the sensitive plant locations. However, the natural resource personnel do not have the last word to direct the training exercises.

**Management Urgency Rank Comments (M2):** Some areas of the grassland are in good condition while others are weedy. *Bromus tectorum* is the only state-listed noxious weed that has been documented at the site. A total of sixteen noxious weeds are known from the Pinon Canyon Maneuver Site (Spackman Panjabi and Decker 2007) and have the potential to infest areas within this site, especially in areas with periodic ground disturbances.

**Exotic Species Comments:** *Bromus tectorum* is the only state-listed noxious weed that has been documented at the site.

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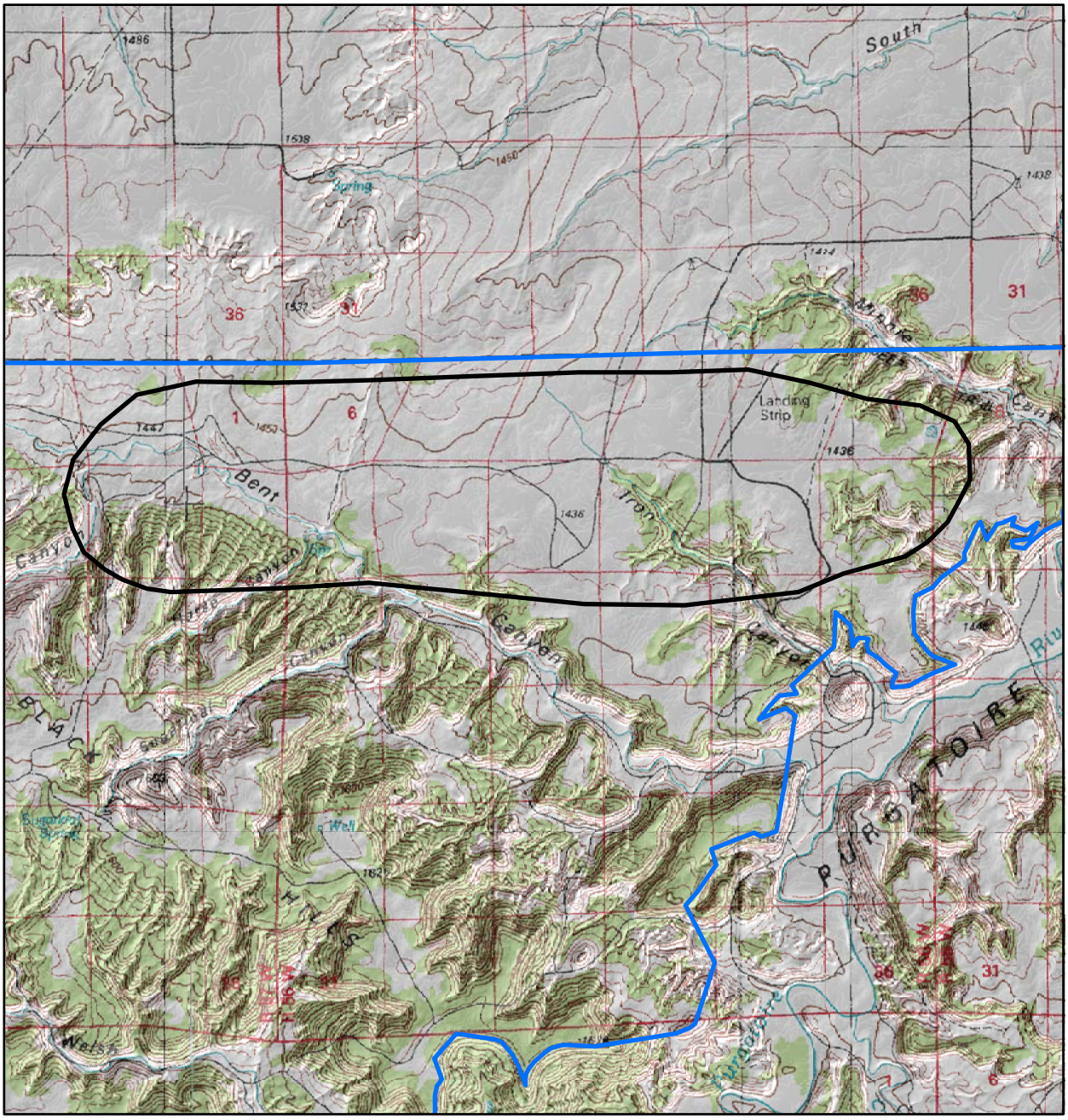


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## Legend

PCA Boundary

PCMS Boundary

La Junta, 37107-E1

30 x 60 Minute Digital Raster Graphic produced by the U.S. Geological Survey

Location in Piñon Canyon Maneuver Site

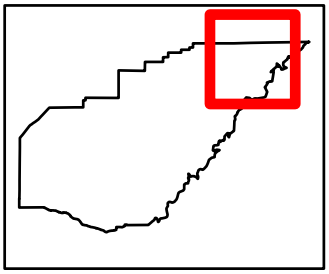

**Figure 7. Northeast Piñon Canyon Maneuver Site Potential Conservation Area, B3: High Biodiversity Significance**

## SUMMARY

The PCMS contains many occurrences of the target species, some of which are Species of Special Concern (Gene Stout and Associates 2007) and Species at Risk (Groves et al. 2000). Many of the PCMS's occurrences are extensive and represent some of the highest quality locations known for the target species in the world. Thus the management of these species at the PCMS will be important for the overall rangewide survival of these species (Grunau et al. 2007). The level of management responsibility and the potential for land use to impact these rare species on the PCMS is high.

Species for which the PCMS has significant management responsibility and potential for impact include:

- **Dwarf milkweed (*Asclepias uncialis* ssp. *uncialis*)**: the PCMS contains 24 percent of the known occupied acres of dwarf milkweed, and 34 percent of the high quality plant occurrences acreage.
- **Arkansas Valley evening primrose (*Oenothera harringtonii*)**: the PCMS contains 17 percent of the known occupied acres of Arkansas Valley evening primrose, and 49 percent of the high quality plant occurrence acreage.
- **Rayless goldenweed (*Oonopsis foliosa* var. *monocephala*)**: the PCMS contains 80 percent of the known occupied acres of rayless goldenweed, and 86 percent of the high quality plant occurrence acreage**.**
- **Round-leaf four-o'clock (*Mirabilis rotundifolia*)** the PCMS contains 12 percent of the known occupied acres of round-leaf four-o'clock, and 13 percent of the high quality plant occurrence acreage. The occurrences at the PCMS are significant because they are very high quality and disjunct from the main portion of the species range.

The rare plant mapping that resulted from these field surveys will facilitate natural resource planning at the PCMS and has provided valuable data about these important elements of biodiversity. Continuing inventory efforts for these rare plant species is warranted. The life history of the target species and other important plant species not targeted in this report make it difficult to evaluate the full potential to which these species occur on the PCMS. The strong response to seasonal moisture causes variable expression of these plants from year to year. Further, the biennial and short-lived perennial habit of several species, such as Arkansas Valley evening primrose, make these species more transient in the landscape; they are known to persist within the vicinity of current known locations for years, but numbers and specific locations of individuals change over time. Initiating and continuing inventory for additional species (both plants and animals) and natural communities will further facilitate natural resource planning. Continuing monitoring efforts for the target species, additional Species of Special Concern on the PCMS, and Species at Risk will inform trends of known occurrences on this military installation.

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## APPENDIX A – NATURAL HERITAGE METHODOLOGY

# The Natural Heritage Network and Biological Diversity

Colorado is well known for its rich diversity of geography, wildlife, plants, and plant communities. However, like many other states, it is experiencing a loss of much of its flora and fauna. This decline in biological diversity is a global trend resulting from human population growth, land development, and subsequent habitat loss. Globally, the loss in species diversity has become so rapid and severe that it has been compared to the great natural catastrophes at the end of the Paleozoic and Mesozoic eras (Wilson 1988). The need to address this loss in biological diversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country have not been based upon preserving biological diversity; instead, they have primarily focused on preserving game animals, striking scenery, and locally favorite open spaces. To address the absence of a methodical, science-based approach to preserving biological diversity, Robert Jenkins, a biologist working with The Nature Conservancy, developed the Natural Heritage Methodology in 1978 (The Nature Conservancy 2000).

Recognizing that rare and imperiled species are more likely to become extinct than common ones, the Natural Heritage Methodology ranks species according to their rarity or degree of imperilment. The ranking system is based upon the number of known locations of the species as well as its biology and known threats. By ranking the relative rarity or imperilment of a species, the quality of its populations, and the importance of associated conservation sites, the methodology can facilitate the prioritization of conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community began to realize that plant communities are equally important as individual species, this methodology has also been applied to ranking and preserving rare plant communities as well as the best examples of common communities.

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. Natural Heritage Network data centers are located in each of the 50 U.S. states, five provinces of Canada, and 13 countries in South and Central America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. It also enables conservationists and natural resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts. For more information on the work of the Natural Heritage Network see www.natureserve.org.

### What is Biological Diversity?

Protecting biological diversity has become an important management issue for many natural resource professionals. Biological diversity at its most basic level includes the full range of species on earth, from unicellular bacteria and protists through multi-cellular plants, animals, and fungi. At finer levels of organization, biological diversity includes the genetic variation within species, both among geographically separated

populations and among individuals within a single population. On a wider scale, diversity includes variations in the biological communities in which species live, the ecosystems in which communities exist, and the interactions among these levels. All levels are necessary for the continued survival of species and natural communities, and all are important for the well being of humans. It stands to reason that biological diversity should be of concern to all people.

The biological diversity of an area can be described at four levels:

1. **Genetic Diversity** -- the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species is variable between populations within its geographic range. Loss of a population results in a loss of genetic diversity for that species and a reduction of total biological diversity for the region. Once lost, this unique genetic information cannot be reclaimed.

2. **Species Diversity** -- the total number and abundance of plant and animal species and subspecies in an area.

3. **Community Diversity** -- the variety of ecological communities within an area that represent the range of species relationships and interdependence. These communities may be characteristic of, or even endemic to, an area. It is within ecological communities that all life dwells.

4. **Landscape Diversity** -- the type, condition, pattern, and connectedness of ecological communities. A landscape consisting of a mosaic of ecological communities may contain one multifaceted ecosystem, such as a wetland ecosystem. A landscape also may contain several distinct ecosystems, such as a riparian corridor meandering through shortgrass prairie. Fragmentation of landscapes, loss of connections and migratory corridors, and loss of natural communities all result in a loss of biological diversity for a region. Humans and the results of their activities are integral parts of most landscapes.

The conservation of biological diversity must include all levels of diversity: genetic, species, community, and landscape. Each level is dependent on the other levels and inextricably linked. Often overlooked is the reality that humans are also linked to all levels of this hierarchy of diversity. The Colorado Natural Heritage Program believes that a healthy natural environment and human environment go hand in hand, and that recognition of the most imperiled species or communities is an important step in comprehensive conservation planning.

Colorado's Natural Heritage Program

CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in Colorado for fourteen years, the Program was relocated

from the State Division of Parks and Outdoor Recreation to the University of Colorado Museum in 1992 and then in 1994 to the College of Natural Resources at Colorado State University.

CNHP's multi-disciplinary team of scientists and information managers gathers comprehensive information on rare, threatened, and endangered species and significant ecological communities of Colorado. Life history, status, and locational data are incorporated into a continually updated data system. Sources include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists, experts, agency personnel, and our own staff of botanists, ecologists, and zoologists. Information management staff oversee the transcription and mapping of the data and physical locations into the BIOTICS data system. BIOTICS combines an Oracle relational database with a geographic information system (Arc/GIS). The data in the database can be accessed through a variety of attributes, including taxonomic group, global and state rarity rank, federal and state legal status, source, observation date, county, quadrangle map, watershed, management area, township, range, and section, precision, and conservation unit.

CNHP is part of an international network of conservation data centers that uses BIOTICS for its data management. CNHP has effective relationships with several state and federal agencies, including the Colorado Natural Areas Program, Colorado Department of Natural Resources and the Colorado Division of Wildlife, the U.S. Environmental Protection Agency, the U.S. Bureau of Land Management and the U.S. Forest Service. Numerous local governments and private entities also work closely with CNHP. Use of the data by many different individuals and organizations, including Great Outdoors Colorado, encourages a proactive approach to development and conservation thereby reducing the potential for conflict. Information collected by the Natural Heritage Programs around the globe provides a means to protect species before the need for legal endangerment status arises.

Concentrating on site-specific data for each species or community enables the evaluation of the significance of each location with respect to the conservation of natural biological diversity in Colorado and the nation. By using species imperilment ranks and quality ratings for each location, priorities can be established for the protection of the most sensitive or imperiled sites. CNHP's BIOTICS is a GIS based priority-setting system that provides land managers with an effective, proactive land-planning tool. For more information on the work of the Colorado Natural Heritage Program please see www.cnhp.colostate.edu.

## The Natural Heritage Ranking System

Each of the plant or animal species and ecological communities tracked by CNHP is considered an **element of natural diversity**, or simply an **element**. Each element is assigned a rank that indicates its relative degree of imperilment on a five-point scale (e.g., 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences, i.e., the number of known distinct localities or populations. The number of occurrences is weighted more heavily than other criteria because an element found in one place is more imperiled than something found in twenty-one places. Also considered in defining the element imperilment rank is the size of the geographic range, the number of individuals, trends in population and distribution, identifiable threats, and the number of already protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State or S-rank) and the element's imperilment over its entire range (its Global 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 5 current locations in Colorado, is ranked G5S1. Naturita milkvetch, which is known from 37 locations in the Four Corners Area, is ranked a G3S3, vulnerable both globally and in Colorado. Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1S1, critically imperiled both globally and in Colorado. CNHP actively collects, maps, and electronically processes specific occurrence information for elements considered extremely imperiled to vulnerable (S1 - S3). Those with a ranking of S3S4 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 Table A-1.

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 Table 1, ranks followed by a "B", e.g., S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N", e.g., 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.

## Legal Designations

Natural Heritage imperilment ranks are not legal designations and should not be interpreted as such. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. State designations apply to animals only; Colorado has no legal list of threatened and endangered plant species (Buckner and Bunin 1992).

In addition, the U.S. Forest Service and Bureau of Land Management recognize some species as “Sensitive”. Table A-2 defines the special status assigned by these agencies and provides a key to the abbreviations used by CNHP.

Please note that the U.S. Fish and Wildlife Service has issued a Notice of Review in the February 28, 1996 Federal Register for plants and animal species that are "candidates" for listing as endangered or threatened under the Endangered Species Act. The revised candidate list replaces an old system that listed many more species under three categories: Category 1 (C1), Category 2 (C2), and Category 3 (including 3A, 3B, 3C). Beginning with the February 28, 1996 notice, the Service will recognize as candidates for listing most species that would have been included in the former Category 1. This includes those species for which the Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act. Candidate species listed in the February 28, 1996 Federal Register are indicated in Table A-2 with a "C".

**Table A-1. Definition of CNHP Imperilment Ranks.**

Global imperilment ranks are based on the range-wide status of a species. State imperilment ranks are based on the status of a species in an individual state. State and Global ranks are denoted, respectively, with an "S" or a "G" followed by a character. **These ranks should not be interpreted as legal designations.**

| | |
|---|---|
| **G/S1** | Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or very few remaining 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 because of other factors demonstrably making it very vulnerable to extinction throughout its range. |
| **G/S3** | Vulnerable throughout its range or found locally in a restricted range (21 to 100 occurrences). |
| **G/S4** | Apparently secure globally/state, though it might be quite rare in parts of its range, especially at the periphery. |
| **G/S5** | Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery. |
| **GX** | Presumed extinct. |
| **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 not verified for an extended period. |
| **G#T#** | Trinomial rank (T) is used for subspecies or varieties. These species or subspecies are ranked on the same criteria as G1-G5. |
| **S#B** | Refers to the breeding season imperilment of elements that are not permanent 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. |

Notes: Where two numbers appear in a state or global rank (e.g., S2S3), the actual rank of the element falls between the two numbers.

Element Occurrence Ranking

Actual locations of elements, whether they are single organisms, populations, or plant communities, are referred to as element occurrences. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. In order to prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to the estimated viability or probability of persistence (whenever sufficient information is available). This ranking system is designed to indicate which occurrences are the healthiest and ecologically the most viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on 3 factors:

**Size** – a quantitative measure of the area and/or abundance of an occurrence such as area of occupancy, population abundance, population density, or population fluctuation.

**Condition** – an integrated measure of the quality of biotic and abiotic factors, structures, and processes within the occurrence, and the degree to which they affect the continued existence of the occurrence. Components may include reproduction and health, development/maturity for communities, ecological processes, species composition and structure, and abiotic physical or chemical factors.

**Landscape Context** – an integrated measure of the quality of biotic and abiotic factors, and processes surrounding the occurrence, and the degree to which they affect the continued existence of the occurrence. Components may include landscape structure and extent, genetic connectivity, and condition of the surrounding landscape.

**Table A-2. Federal and State Agency Special Designations.**

**Federal Status:**

1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)

**LE** Endangered; species or subspecies formally listed as endangered.

**E(S/A)** Endangered due to similarity of appearance with listed species.

**LT** Threatened; species or subspecies formally listed as threatened.

**P** Potential Endangered or Threatened; species or subspecies formally listed as potentially endangered or threatened.

**PD** Potential for delisting

**C** Candidate: species or subspecies for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.

2. U.S. Forest Service (Forest Service Manual 2670.5) (noted by the Forest Service as "S")

**FS** Sensitive: those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by:

a. Significant current or predicted downward trends in population numbers or density.

b. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

3. Bureau of Land Management (BLM Manual 6840.06D) (noted by BLM as "S")

**BLM** Sensitive: those species found on public lands, designated by a State Director that could easily become endangered or extinct in a state. The protection provided for sensitive species is the same as that provided for C (candidate) species. This list does not include species that are listed endangered (LE) or threatened (LT).

**State Status:**

1. Colorado Division of Wildlife

**CO-E** Endangered
**CO-T** Threatened
**CO-SC** Special Concern

Each of these factors is rated on a scale of A through D, with A representing an excellent grade and D representing a poor grade. These grades are then averaged to determine an appropriate EO-Rank for the occurrence. If there is insufficient information available to rank an element occurrence, an EO-Rank is not assigned. Possible EO-Ranks and their appropriate definitions are as follows:

**A** Excellent estimated viability.
**B** Good estimated viability.
**C** Fair estimated viability.
**D** Poor estimated viability.
**E** Viability has not been assessed.
**H** Historically known, but not verified for an extended period of time
**X** Extirpated

Potential Conservation Areas

In order to successfully protect populations or occurrences, it is necessary to delineate areas needed for their conservation. These "Potential Conservation Areas" (PCA) focus on capturing the ecological processes that are necessary to support the viable persistence of an element occurrence. A PCA may include a single occurrence of an element or a suite of element occurrences. Not all element occurrences are included in PCA's. PCA's are ordinarily drawn for A to C ranked G1 to G3 and S1 or S2 elements only. Other lower ranked element occurrences may fall geographically within the site boundaries, and are thus included, but would not warrant a PCA on their own.

The goal of the process is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence or suite of element occurrences depends for its continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, as well as current and potential land uses. CNHP PCA's are referred to by the BLM as "Areas of Biological Significance".

In developing PCA boundaries, CNHP biologists consider a number of factors that include, but are not limited to:

- the extent of current and potential habitat for the elements present, considering the ecological processes necessary to maintain or improve existing conditions;

- species movement and migration corridors;

- maintenance of surface water quality within the site and the surrounding watershed;

- maintenance of the hydrologic integrity of the groundwater, e.g., by protecting recharge zones;

- land intended to buffer the site against future changes in the use of surrounding lands;

- exclusion or control of invasive exotic species;

- land necessary for management or monitoring activities.

**The proposed boundary does not recommend the exclusion of all activity.** It is hypothesized that some activities will prove degrading to the element or the process on which the element depends, while others will not. Specific activities or land use changes proposed within or adjacent to the PCA boundary should be carefully considered and evaluated for their implications to the survival of the elements for which the PCA is primarily defined and the other elements that also fall within the site.

The PCA boundaries presented here are for planning and management purposes. They delineate ecological areas where land-use practices should be carefully planned and managed to ensure compatibility with protection goals for natural heritage elements. Please note that PCA boundaries are based primarily on our understanding of the ecological systems. A thorough analysis of the human context and potential stresses was not conducted. All land within the conservation planning boundary should be considered an integral part of a complex economic, social, and ecological landscape that requires thoughtful land-use planning at all levels.

Off-Site Considerations

It is often the case that all relevant ecological processes cannot be contained within a PCA of reasonable size. For instance, while a PCA for Colorado River cutthroat trout may be drawn to include only a portion of the riparian zone of a river or creek, it should be noted that the ecological functions that determine the viability of the occurrence operate at the watershed scale. Activities throughout the entire watershed can affect water quality and hydrology of the river, which in turn may affect the trout's local habitat and population viability. The boundaries illustrated in this report signify the immediate, and therefore most important, area in need of protection. Continued landscape level planning and conservation efforts are needed. This requires coordination and cooperation with private landowners, neighboring land planners, and state and federal agencies with jurisdictions and interests across the landscape.

Ranking of Potential Conservation Areas

Biological Diversity Rank

CNHP uses element and element occurrence ranks to assess the biological diversity significance of a site. If an element occurrence is unranked due to a lack of information, the element occurrence rank is considered a C rank. Similarly, if an element is a "GU" or "G?" it is treated as a "G4". Based on these ranks, each site is assigned a **Biological Diversity rank (B rank)**:

**B1** Outstanding Significance: the only site known for an element or an excellent occurrence of a G1 species.

**B2** Very High Significance: one of the best examples of a community type, good occurrence of a G1 species, or excellent occurrence of a G2 or G3 species.

**B3** High Significance: excellent example of any community type, good occurrence of a G3 species, or a large concentration of good occurrences of state rare species.

**B4** Moderate or Regional Significance: good example of a community type, excellent or good occurrence of state-rare species.

**B5** General or Statewide Biological diversity Significance: good or marginal occurrence of a community type, S1, or S2 species.

**Protection Urgency Ranks**

Protection urgency ranks (P-ranks) refer to the time frame in which conservation protection should occur in order to prevent the loss of the element. In most cases, this rank refers to the need for a major change of protective status (e.g., agency special area designations or ownership). The urgency for protection rating reflects the need to take legal, political, or other administrative measures to alleviate potential threats that are related to land ownership or designation. The following codes are used to indicate the urgency to protect the area:

**P1** May be immediately threatened by severely destructive forces, within 1 year of rank date,
**P2** Threat expected within 5 years,
**P3** Definable threat but not in the next 5 years,
**P4** No threat known for foreseeable future,
**P5** Land protection complete, or adequate reasons exists not to protect the site.

A protection action involves increasing the current level of legal protection accorded one or more tracts of a potential conservation area. Protection strategies on public lands may include special designations such as Wilderness, Research Natural Areas (RNA), or Areas of Critical Environmental Concern (ACEC). They may also include activities such as educational or public relations campaigns or collaborative planning efforts with public or private entities to minimize adverse impacts to element occurrences at a site. Protection in this sense does not include management actions.

**Management Urgency Ranks**

Management urgency ranks (M-ranks) indicate the time frame in which a change in management of the element or site must occur in order to ensure the element's future existence. Using best scientific estimates, this rank refers to the need for management in contrast to protection (e.g., increased fire frequency, decreased grazing, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences in the PCA.

A management action may include biological management (prescribed burning, removal of exotics, mowing, etc.) or people and site management (building barriers, rerouting trails, patrolling for collectors, hunters, or trespassers, etc.). It may also include conducting further research or monitoring. Management action does not include legal, political, or administrative measures taken to protect a potential conservation area. The following codes are used to indicate the action needed at the area:

- **M1** Management action may be required immediately or element occurrences could be lost or irretrievably degraded within one year,
- **M2** New management action may be needed within 5 years to prevent the loss of element occurrences,
- **M3** New management action may be needed within 5 years to maintain current quality of element occurrences,
- **M4** Although the element is not currently threatened, management may be needed in the future to maintain the current quality of element occurrences,
- **M5** No serious management needs known or anticipated at the site.

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# APPENDIX B – SPECIES PROFILES

## State Name: *Asclepias uncialis* ssp. *uncialis* (dwarf milkweed)
## Global Name: *Asclepias uncialis* ssp. *uncialis* (Greene's Milkweed)

**Taxonomy**
Class: Dicotyledoneae
Order: Gentianales
Family: Asclepiadaceae

Taxonomic Comments: *A. uncialis* ssp. *uncialis* in the Kartesz (1994) sense is the same entity as *A. uncialis* sensu stricto (excluding *A. uncialis* ssp. *ruthiae*).

**Ranks and Status**
Global Rank: G3G4T2T3
State Rank: S2
Federal Protection Status: BLM and USFS Sensitive Species
State Protection Status: None

**Description and Phenology**
Non-Technical Description: A small, herbaceous perennial with several to many stems 1 to 2.5 inches high. Stems have milky sap. Leaves are primarily opposite, and are of two different forms - lower leaves are oval to lanced shaped, while upper leaves are much narrower. Flowers have five reflexed petals with attendant hoods and horns. Flowers of *A. uncialis* ssp. *uncialis* are rose-purple, appearing in clusters at the tips of the stems, and are reported to have a strong fragrance (Zimmerman 1993).

Diagnostic Characteristics: Small stature, early blooming period, and heterophyllous leaves are diagnostic field characteristics.

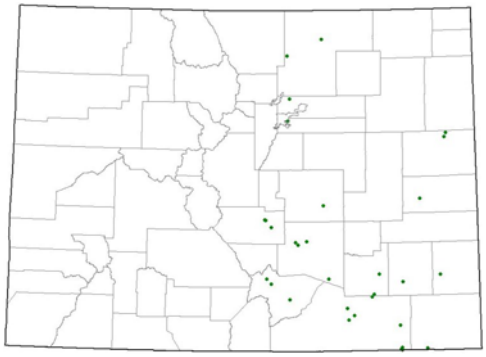
Look Alikes: The small stature, early blooming period, and heterophyllous leaves distinguish *Asclepias uncialis* ssp. *uncialis* from the sympatric and similarly small-sized *A. pumila*, which has white flowers, blooms from July to September, and has only filiform leaves (Locklear 1991). The low-growing *A. involucrata* may also be found in the southern portion of the range of *A. uncialis* ssp. *uncialis*. It has greenish-white flowers, blooms later than *A. uncialis* ssp. *uncialis*, and has longer leaves that are uniformly lanceolate (Locklear 1996).

Phenology: *Asclepias uncialis* ssp. *uncialis* is the earliest blooming milkweed in the Great Plains (Great Plains Flora Association 1986) although its flowering period can potentially overlap those of a few other species in its range (e.g., *A. asperula*, *A. speciosa*, and *A. involucrata*). In Colorado, flowering begins in late April and extends to the end of May. The small population in Weld County, Colorado, that did not flower in the dry spring of 2006 was observed flowering in early August of the same year after some substantial summer rains.

**Habitat**
Typical habitat for *Asclepias uncialis* ssp. *uncialis* is level to gently sloping terrain without notable micro-topographic features. Although plants are often found at the base of escarpments or mesas, the species does not occur on rock ledges or outcroppings, and is absent from highly disturbed habitats such as sand dunes, erosion channels, wash slopes, and badlands. Elevations of extant occurrences in Colorado range from 3,920-7,640 feet (1,190-2,330 m). Soils in the range of *A. uncialis* ssp. *uncialis* belong to orders characterized by dry, warm soils (Mollisols, Entisols, Aridisols, and Alfisols). *Asclepias uncialis* ssp. *uncialis* does not appear to have highly specific microsite requirements, and there is no evidence that *A. uncialis* ssp. *uncialis* is restricted to a particular soil type. Occurrences are known from soils derived from a variety of substrates, including sandstone, limestone, and shale, but are most often found in sandy loam soils. It does not occur in pure sand.
*Asclepias uncialis* ssp. *uncialis* is primarily associated with species typical of shortgrass prairie. Associated vegetation is comprised mostly of grasses, with forbs, shrubs, and trees typically comprising less than 15% of the total vegetation cover. Plants are typically found growing in open spaces between bunch grasses. Associated forbs are variable throughout the range, since many species found with *A. uncialis* ssp. *uncialis* in southeastern Colorado (e.g., *Melampodium leucanthum*) are near the northern edge of their distribution in that area (Locklear 1996). Although *A. uncialis* ssp. *uncialis* is often associated with Juniper Woodland and Savanna ecological systems, it is always found in the prairie or grassland components of these systems.

**Distribution**
Global Range: Historically, this species appears to have been known from two or three disjunct geographical areas: 1) the western Great Plains of eastern Colorado, northeastern New Mexico, and the adjacent Oklahoma panhandle; 2) central to southwestern New Mexico and scattered locations in Arizona; and 3) Sweetwater County in southwestern Wyoming. Some botanists consider the location of the Wyoming collection (*C.C. Parry #246*) to be an error in labeling and speculate that it may have come from northeastern Colorado (Fertig 2000, Fishbein personal communication 2004). Recent observations (i.e., those less than 20 years old) are confined to the first two areas mentioned plus a few observations in central New Mexico. Based on collection location and frequency, the range of the species appears to have contracted in northeastern Colorado since the mid to late 1800's.

Colorado State Range: Estimated range is 71,964 square kilometers (27,785 square miles), calculated in GIS by drawing a minimum convex polygon around the known occurrences. There is potentially about 40,000 square miles of habitat in eastern Colorado (although perhaps as much as 50% of this area is no longer suitable habitat), roughly 45% of the total potential range of the species. The current known distribution of *Asclepias uncialis* ssp. *uncialis* forms an arc along the flank of the Southern Rocky Mountains from northeastern Colorado to southwestern New Mexico and adjacent southeastern Arizona. Currently known from nine Colorado counties (Las Animas, Weld, Kit Carson, Huerfano, Pueblo, Otero, Prowers, Fremont, and El Paso), and historically known from at least five additional counties (Baca, Bent, Washington, Cheyenne, and Denver). Occurrences are primarily in southeastern Colorado.



**Threats and Management Issues**

The primary threat at this time is considered to be agricultural development. It is not known if all of the occurrences are or are not threatened by these activities. In general, *A. uncialis* ssp. *uncialis* habitat, shortgrass prairie, is threatened by extensive human alterations for agricultural, residential, and recreational uses. Specific threats to extant occurrences include: recreational use, agricultural use, and military tank traffic. Based on available information, there are several threats to the persistence of *A. uncialis* ssp. *uncialis*. In order of decreasing priority, other threats are population limitation by unknown biological requirements, altered disturbance regime, habitat loss, spread of exotic species, and global climate change. A lack of understanding of population trends and habitat conditions for *A. uncialis* ssp. *uncialis* , and the lack of knowledge about its life cycle, population extent, and demographics also contribute to the possibility that one or more of these factors will threaten the long-term persistence of the species (Decker 2006). Locklear (1996) identified several patterns exhibited by *Asclepias uncialis* ssp. *uncialis* that are of concern: 1) *A. uncialis* ssp. *uncialis* is often not found at historical sites that retain native vegetation. In these cases, absence of *A.uncialis* ssp. *uncialis* may be due to causes peculiar to the biology of *A.uncialis* ssp. *uncialis*, instead of habitat degradation, 2) Most of the known populations are small, discrete, and isolated from each other. Large areas of intervening, apparently suitable habitat are not occupied. Gene flow between these isolated populations is unlikely, and may lead to a decline in species viability over time, and 3) *A.uncialis* ssp. *uncialis* exhibits extremely low rates of sexual reproduction, perhaps even lower than is characteristic of the genus. Although known populations are exposed to grazing, potential recreational use and development, and military training maneuvers, the degree of threat from these disturbances is not known.

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**Version Date:** 12/20/2007

## State Name: *Oxybaphus rotundifolius* (round-leaf four-o'clock)
## Global Name: *Mirabilis rotundifolia* (Round-leaf Four-o'clock)

**Taxonomy**
Class: Dicotyledoneae
Order: Caryophyllales
Family: Nyctaginaceae

**Ranks and Status**
Global Rank: G2
State Rank: S2
Federal Protection Status: None
State Protection Status: None

**Description and Phenology**
Non-Technical Description: A perennial herb with round, densely soft-hairy, opposite leaves and trumpet-shaped magenta flowers in bloom in the summer (the flowers close by mid-morning). *Mirabilis rotundifolia* may be nearly glabrous to stiffly, densely hirsute.

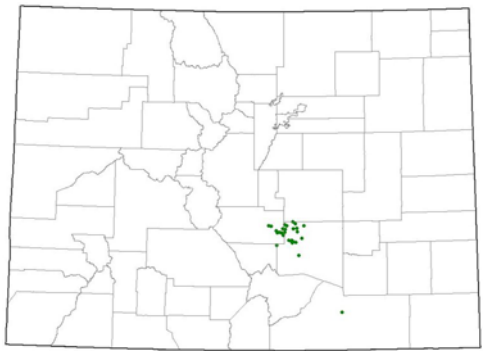
Look Alikes: *M. multiflora* is sympatric but is much larger, has glabrous and glaucous leaves. *Oxybaphus rotundifolius* generally has round leaves while *O. hirsutus* generally has oblong-ovate leaves (pers. comm. Minton 94-11-09). *O. rotundifolius* may be nearly glabrous to stiffly, densely hirsute. *O. hirsutus* is a buffalo wallow plant on the plains; it is not sympatric with *O. rotundifolius*. In vegetative state, *O. rotundifolius* is superficially similar to local species of *Penstemon* with glaucous, pointed leaves (pers. comm. Coles 1994).

Phenology: Flowering occurs from early to mid-June and the flowers open before dawn and remain open until approximately 9 a.m.). In 1990 the plants had not emerged by April 15, and were just greening up by mid-May. In 1989 they were too dry to be seen readily by mid July (Naumann 1990).

**Habitat**
*Mirabilis rotundifolia (Oxybaphus rotundifolius)* is generally restricted to outcrops of the lower shale unit of the Smoky Hill member of the Cretaceous Niobrara Formation. The plant community is sparse shrubland or woodland with a barren aspect. Frequent associates are James' frankenia *(Frankenia jamesii)* and oneseed juniper *(Juniperus monosperma)*. Elevations range from 4790 to 5610 feet (1460 to 1710 m).

**Distribution**
Global Range: Endemic to Colorado; known from Fremont, Las Animas, and Pueblo

counties. Estimated range is 3,732 square kilometers (1,441 square miles), calculated in GIS by drawing a minimum convex polygon around the known occurrences.



**Threats and Management Issues**

Residential development is considered to be the primary threat to the species at this time. Highly threatened by residential and recreational development (Naumann 1990). Three sites are bisected by state highways and may be impacted by road use and maintenance. Predation by Hawk Moth Caterpillars (horn worms) may be a problem (pers. comm. Kelso 1996).

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**Version Date:** 12/18/2007

## State Name: *Oenothera harringtonii* (Arkansas Valley evening primrose)
## Global Name: *Oenothera harringtonii* (Arkansas Valley Evening-primrose)

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

**Ranks and Status**
Global Rank: G2G3
State Rank: S2S3
Federal Protection Status: USFS Sensitive Species
State Protection Status: None

**Description and Phenology**
Non-Technical Description: *Oenothera harringtonii* is an annual or biennial, perhaps occasionally a short-lived perennial. Plants have a stout taproot with one to five stems rising from a basal rosette. Plants stand 15-40 cm tall and support large white flowers with petals that are 2-2.6 cm long. The stems are yellowish-fawn color, usually with reddish-purple splotches. Plants flower from mid-May to June, with five to ten flowers per stem opening each day. Petals are white, fading to pink, and flowers have a heavy fragrance.

Look Alikes: Similar to *O. caespitosa* ssp. *macroglottis* whose range overlaps that of *O. harringtonii* in Fremont county. Because of their greatly different habitats they are rarely found growing together. One exception is along the Arkansas River between Parkdale and Canon City, where *O. caespitosa* ssp. *macroglottis* atypically occurs in a nonmontane habitat along the river. Intermediates have not been observed. The perennial *O. caespitosa* ssp. *macroglottis* has all basal leaves, notched corolla lobes, lower numbers of capsules per stem, and lower seed production. *O. caespitosa* ssp. *macroglottis* has a sweet fragrance as opposed to the strong "gardenia-like" fragrance of *O. harringtonii* (Wagner et al. 1995).

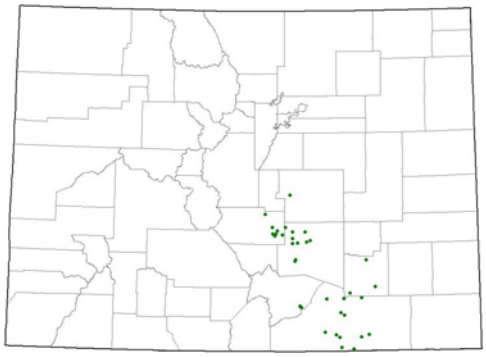
Phenology: Flowering mid May through June. Though *O. harringtonii* is typically annual, some individuals, especially from the southern part of the range, appear to overwinter and flower for at least a second season (Wagner et al. 1985).

**Habitat**

*Oenothera harringtoni*i habitat is typically flat or gentle slopes in open shortgrass or saltbush communities. Plants are often found on compacted, silty clay soil, but may also grow on rocky, sandy, and silty loam soils. Substrates are often derived from shale and limestone formations, including the Niobrara formation, Carlile shale, Greenhorn limestone, Graneros shale, and Pierre shale formations. This species is known from an elevation range of about 4,600-6,100 feet.

**Distribution**

Global Range: Colorado endemic (El Paso, Fremont, Huerfano, Las Animas, Otero, and Pueblo counties). Estimated range is 15,693 square kilometers (6,059 square miles), calculated in GIS by drawing a minimum convex polygon around the known occurrences. Probably in adjacent New Mexico (Wagner et al. 1985).



**Threats and Management Issues**

Residential development is considered to be the primary threat to the species at this time. Habitat loss due to urbanization, road development projects, and resource extraction activities, especially quarrying and surface mining, is a substantial threat to *Oenothera harringtonii*. Since several known occurrences are near highways, roadside maintenance activities, such as herbicide use, may impact the several known occurrences that are near highways. Recreational use of habitat is a threat to at least one occurrence at a Colorado state park. Invasion of habitat by non-native plant species is a potential threat throughout the range of this non-competitive species. Two classes of weeds pose substantial problems. Noxious weeds, such as field bindweed (*Convolvulus arvensis*) and jointed goatgrass (*Aegilops cylindrica*), and escaped non-native species used for agriculture and restoration, such as sweetclover (*Melilotus* spp.) and Mexican-fireweed (*Kochia scoparia*), have both been recorded at current occurrences. Livestock grazing, especially during flowering and fruiting periods, is likely to reduce the reproductive output of this species. This is a significant threat because *O. harringtonii* relies on seed production rather than vegetative reproduction to maintain its populations. Long-term sustainability of *O. harringtonii* populations is also jeopardized by declines in pollinator populations. The small size of many populations confers susceptibility to local extirpation from genetic, demographic, and environmental stochasticities (Ladyman 2005).

**References**

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**Version Date:** 12/05/2007

## State Name: *Oonopsis foliosa* var. *monocephala* (rayless goldenweed)
## Global Name: *Oonopsis foliosa* var. *monocephala* (Single-head Goldenweed)

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

Taxonomic Comments: Synonyms include *Haplopappus fremontii* ssp.*monocephalus* (used by USFWS 9/93), and *Oonopsis foliosa.*

**Ranks and Status**
Global Rank: G3G4T2
State Rank: S2
Federal Protection Status: None
State Protection Status: None

**Description and Phenology**
Non-Technical Description: A perennial herb generally 10-40 cm tall, arising from a woody taproot. Vegetative reproduction via one or two horizontal, spreading, sprouting branch roots is common. The erect stems are glabrous or very sparsely hairy, with numerous entire, alternate, oblanceolate leaves of 5-15 cm in width. Involucre up to 35 mm wide and 25 mm tall. Phyllaries obtuse to acute, in 2 or more series, subequal or imbricate, ray flowers are absent.

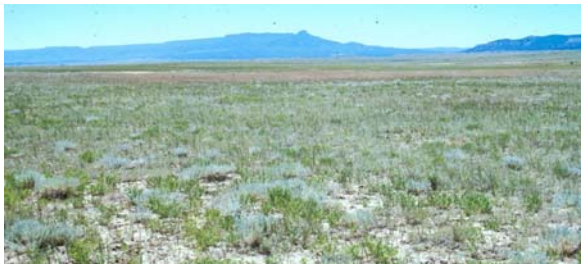
Diagnostic Characteristics: The lack of ray flowers distinguishes this species from sysmpatric *Oönopsis* species, although hybrids between var. *monocephala* and var. *foliosa* may exhibit a gradual transition from discoid to radiate morphology (Hughes and Brown 1994).

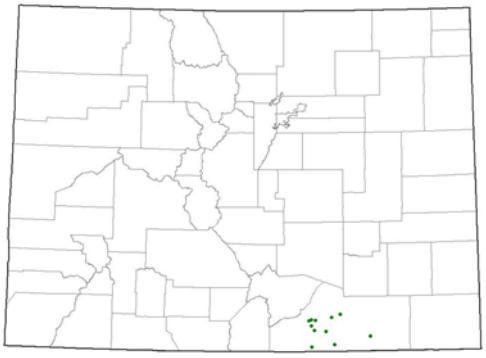
Phenology: Flowers June-July.

**Habitat**
This species is most often found in sparsely vegetated areas on or near highly eroded shale and clay slopes, including disturbed areas such as two-tracks. Soils are typically dry, fine-grained and clayey. Within the shortgrass prairie matrix, it may be associated with a variety of semi-arid grassland and shrubland associations, including those dominated by *Bouteloua gracilis, Frankenia jamesii, Krascheninnikovia lanata, Sarcobatus vermiculatus,* and *Yucca glauca.* Elevation range is 4000-6000 ft.

**Distribution**
Global Range: Colorado endemic (Las Animas County). Estimated range is 2,182 square kilometers (842 square miles), calculated in GIS by drawing a minimum convex

polygon around the known occurrences.





**Threats and Management Issues**

Road construction and maintenance are considered to be the primary threats to the species at this time. Most of the individuals occur on private cattle ranches and on the DoD's Pinyon Canyon Maneuver Site. There are several highways, roads, and telephone lines throughout the occurrences. Although the species seems to tolerate a moderate level of disturbance, maintenance or further developments may adversely disturb or destroy individuals. Housing or commercial development may be a threat in the future.

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**Version Date:** 12/05/2007