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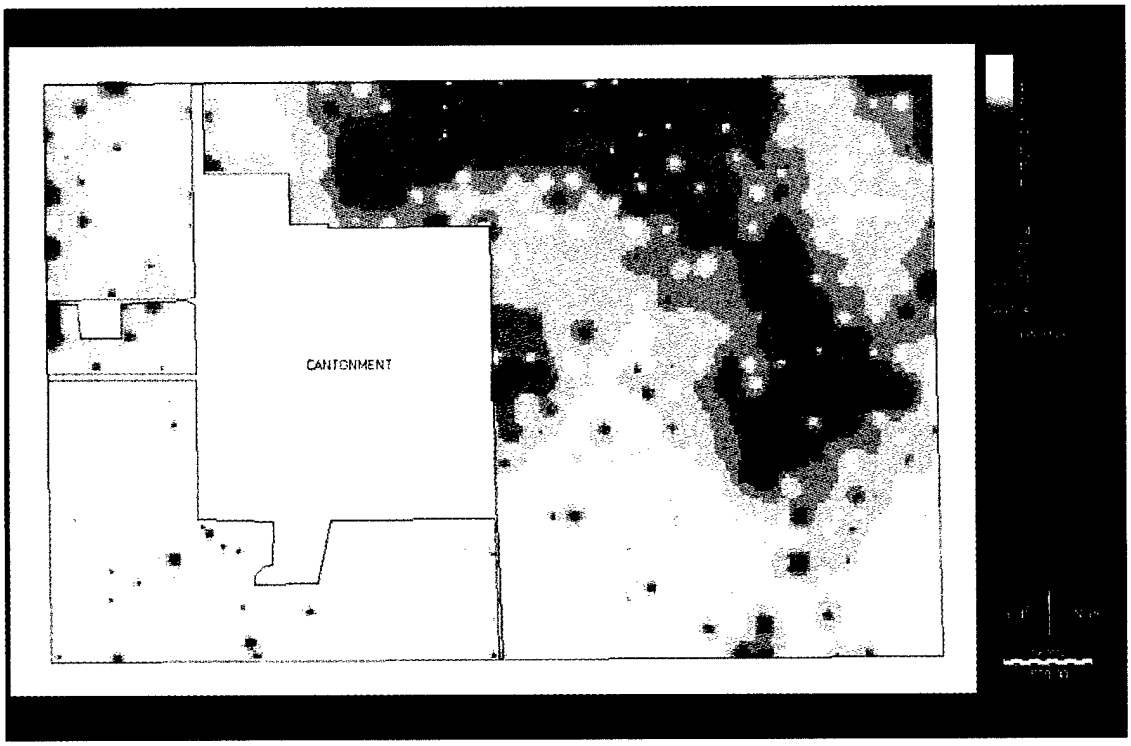
Invasive Plant Species Survey and Management Guidelines for Schriever Air Force Base, Colorado

Patrick J. Guertin and Matthew G. Hohmann

December 2001



Construction Engineering Research Laboratory

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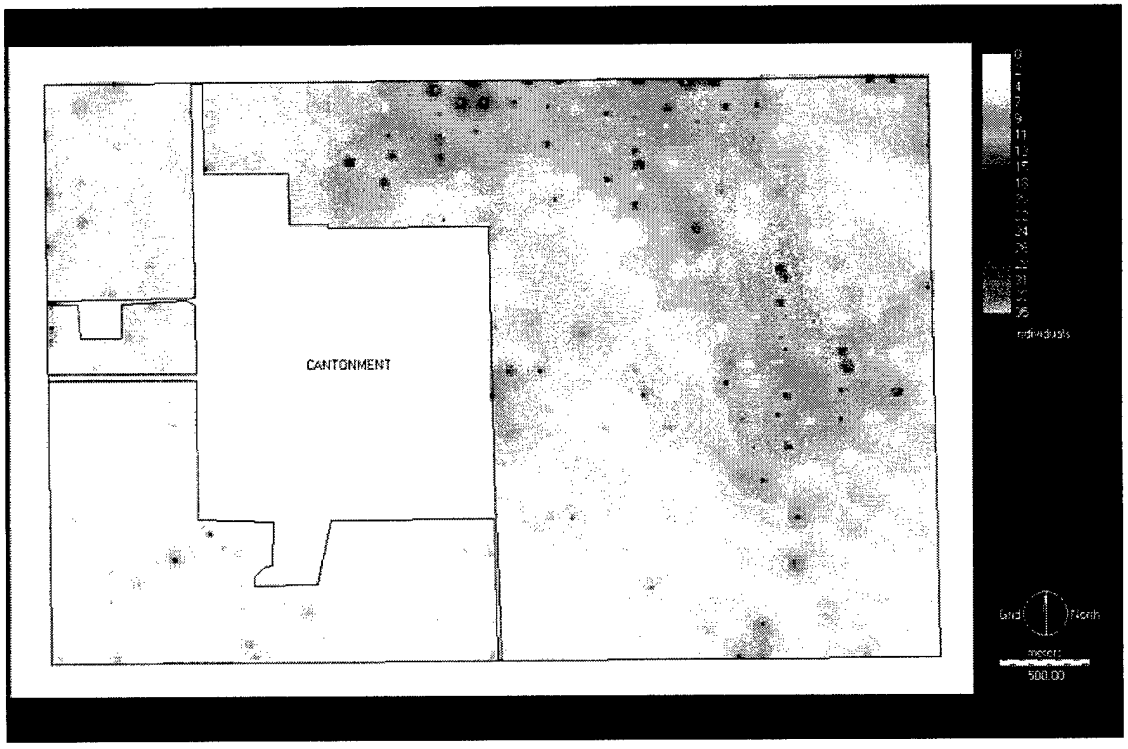

Foreword

This study was conducted for Schriever Air Force Base under under Military Interagency Purchase Request No. 99460095/PO dated September 1999, "GIS/Autocad, Noxious Weeds on Schriever AFB," Work Unit SC9. The technical monitor was Mr. Ralph Mitchell.

The work was performed by the Ecological Processes Branch CN-N of the Installations Division CN, Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Patrick J. Guertin. The technical editor was Gloria J. Wienke, Information Technology Laboratory. Steve Hodapp is Chief, CEERD-CN-N, and Dr. John T. Bandy is Chief, CEERD-CN. The associated Technical Director was Dr. William D. Severinghaus, CEERD-CV-T. The Director of CERL is Dr. Alan W. Moore.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL John Morris III, EN and the Director of ERDC is Dr. James R. Houston.

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1 Introduction

Background

For the Schriever Air Force Base (AFB) natural resource/environmental office staff to better meet compliance and stewardship responsibilities regarding (1) invasive weed control within installation boundaries, (2) invasive weed impacts on stocking rates on agricultural out lease lands, and (3) DoD requirements for reduced pesticide use, detailed information is needed to document the species, location, and density of invasive weed populations on the installation. With these considerations in mind, Natural Resources specialists from the Ecological Processes Branch of the Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL) developed a study to document invasive weed populations on Schriever AFB lands and provide management guidelines.

Objectives

The objectives of this work are to document/map invasive/noxious weed populations on Schriever AFB non-cantonment lands, and to develop management guidelines for documented invasive weed populations.

Approach

Work conducted under this project included comprehensive field surveys to document the invasive weed populations on Schriever AFB lands, and a literature search to develop control (management) plans based on current methodologies. Protocols used to document the distribution and abundance of weed populations are defined in Chapter 2. Recommendations for control strategies are reported in Chapter 4 and focus on non-chemical methods wherever possible.

Scope

All activities associated with the documentation of invasive/noxious weeds on Schriever AFB are limited to the non-cantonment areas(undeveloped lands) of the installation. By invasive species, it is meant, non-native species that invade habitats and displace native species.

The weed population mapping focused on species found on the State of Colorado "State Noxious Weed List" as authorized by the Colorado Weed Management Act §§ 35-5.5-101 through 119, Colorado Revised Statues (C.R.S.). Management guidelines focus on the eight species locally enforced by the El Paso County, Colorado, Department of Forestry and Noxious Weeds.

Mode of Technology Transfer

This report will be made accessible through the World Wide Web (WWW) at URL:

http://www.cecer.army.mil

Units of Weight and Measure

U.S. standard units of measure are used throughout this report. A table of conversion factors for Standard International (SI) units is provided below.

SI conversion factors		
1 ft	=	0.305 m
1 acre	=	0.405 ha
1 mi	=	1.609 km
1 lb	=	0.453 kg

2 Site Description and Methods

Site Description

Schriever AFB is located approximately 10 miles East of Colorado Springs, Colorado. The installation consists of approximately 4,000 acres, of which 3,000 acres is gently rolling hills, dominated by a mix of native grassland species. The remaining acreage contains installation buildings and other facilities.

Mapping Strategies

Mapping of invasive weed populations in non-cantonment areas was conducted using two strategies. The first strategy was designed to identify and document the existence of species occurring on the installation and to collect for data that could be used to generate map layers representing general population densities across the installation. This strategy is based on a systematic sampling scheme. The second strategy was designed to map individual populations of invasive species that represent problem areas needing control/management. This methodology was site specific and not only identifies problem areas, but also can be used as the basis for a comprehensive monitoring plan to judge the effectiveness of control strategies, since it maps the exact boundaries of the species in question.

Systematic Mapping

The non-cantonment area (approximately 3,000 acres) was subdivided into smaller sampling areas (i.e., "blocks") based on existing fence lines. Each block is approximately 24 to 345 acres. Individual blocks were sampled using 1/10-acre plots spaced along a grid at 500-ft intervals. Plots were 66 ft by 66 ft with their sides lining up with the cardinal directions of the compass (North, South, East, and West). This resulted in 609 plots being established, which is approximately a 2 percent sample size. Within each plot, invasive species were tallied using one of two methods. Species commonly occurring in lower densities or with easily differentiated stems (e.g., thistle) were tallied by individual stem count. Species that usually occurred at high densities or with a low bushy form not easily differentiated by individual stems, were tallied by percent cover. The center

of each plot was georeferenced using a Global Positioning System (GPS) unit so the data could be easily mapped in a geographic information system (GIS). In addition to tallying species within plots, this method provided the opportunity to examine all areas of rangeland for the presence of invasive species.

Site-Specific Mapping

Once the installation was inventoried using the systematic sampling system described above, areas containing invasive species listed on the El Paso County list of noxious weeds were revisited and mapped. The procedure for mapping was to delineate the population boundary and record it using a GPS unit. A measure of stem density was also recorded. Stem density was measured as either the number of stems or percent cover, as described above.

GIS Mapping

Data collected in the field was imported into ArcView 3.0 to produce layers defining the location and abundance of invasive weed species on Schriever AFB. This mapping was accomplished in one of two ways, depending on the data collection procedures that were used. In the first approach, the plot data collected under the systematic design were imported into the GIS as points and interpolated across the installation. The interpolation process used a simple distance weighted exponent approach. Typically, an exponent between 1.5 and 2.5 was chosen. For example, an exponent of 2 yields a weight equal to the inverse of the distance squared. The map layers generated by this method represent generalized weed densities across the installation. The second mapping approach used the site-specific data, which were imported directly into ArcView 3.0 as polygons.

3 Results

Eight species of noxious weeds listed by the Colorado Noxious Weed Act were identified on installation property (Table 1).

Table 1. Invasive species found on Schriever, AFB non-cantonment lands.

Common Name	Scientific Name	Acreage	Category*	Figure
Diffuse knapweed	*Centaurea diffusa*	3.0	A	1, 2
Canada thistle	*Cirsium arvense*	1.9	A	3, 4
Field bindweed	*Convolvulus arvensis*	25.4	A	5
Yellow Sweetclover	*Melilotus officinalis*	2023.7	B	6
Russian thistle	*Salsola iberica*	2382.7	B	7
Goatsbeard	*Tragopogon dubius*	59.0	B	8
Tumble mustard	*Sisymbrium altissimum*	34.9	B	9
Kochia	*Kochia scorpia*	38.4	C	10

*A = Colorado top 10 weed species.

B = Not known as widespread in state, but has economic impact.

C = Other listed state species.

For each of the eight invasive species present on the installation, a GIS map layer depicting general population densities was developed using data from the systematic survey. (See Figures 1 through 10*).

Of the eight listed species detected, two are found on the El Paso County list of noxious weeds. These were diffuse knapweed (*Centaurea diffusa*), and Canada thistle (*Cirsium arvense*). Diffuse knapweed is present in a 3.0-acre (approx) patch along the east side of Enoch Road. The Canada thistle population is found in several patches totalling approximately 1.9 acres in rangeland bordering the west side of Enoch Road. The distribution of diffuse knapweed and Canada thistle are represented in Figures 1 through 4. Figures 1 and 3 represent the extrapolated population densities of the respective species as mapped using the systematic method. Figures 2 and 4 are maps of actual population boundaries constructed using the site-specific methods.

* All figures are located at the end of this chapter.

In addition to the two species listed above, the plant inventory of Schriever AFB lands conducted in July 2000 by the Colorado Natural Heritage Program (Fayette et al. 2000), lists cheatgrass (*Bromus tectorum*) as being present on installation lands. This survey provided no evidence of cheatgrass existing on installation property. The Heritage survey did not list diffuse knapweed or Canada thistle.

In addition to the exotic species listed by the State of Colorado, several species of native and exotic plants commonly classified as weeds (Whitson et al. 1999) by range scientists were found on the installation. These species are considered undesirable for rangeland and livestock management for various reasons, including unpalatability and toxicity. Many of these species are also ruderal, meaning they colonize disturbed areas and quickly dominate and push out desirable forage species. Only one species, wavyleaf thistle (*Cirsium undulatum*), fits this definition of "weed" with great enough frequency to be effectively mapped. Table 2 lists the rangeland weed species found on installation lands. These species are not a management priority of this report so management guidelines are not given; the species are included only for possible grazing management interests.

Table 2. Rangeland weed species found on Schriever AFB.

Common Name	Scientific Name
Marshelder	*Iva xanthifolia*
Horseweed	*Conyza canadensis*
Purple aster	*Machaeranthera canescens*
Velvety gaura	*Gaura parviflora*
Wavyleaf thistle*	*Cirsium undulatum*
Dock spp	*Rumex spp.*
Lupine spp	*Lupine spp.*

* See Figure 11 for the corresponding map layer.

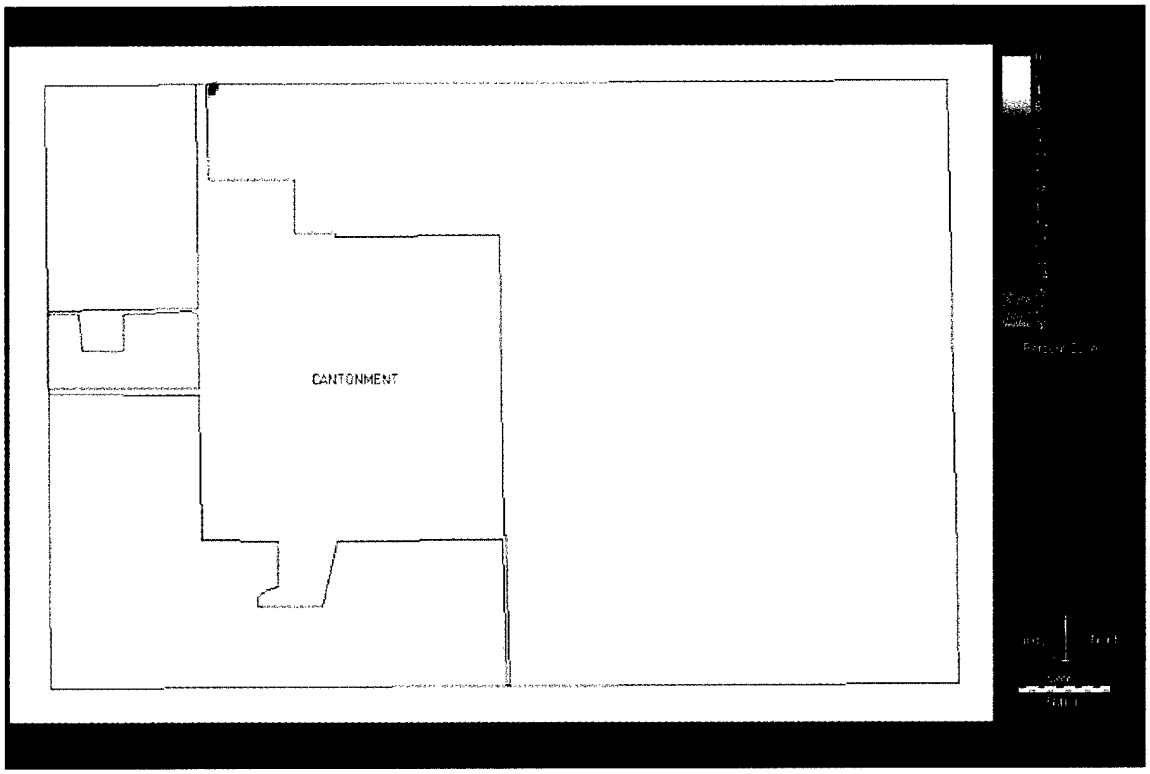

Figure 1. General population distribution of diffuse knapweed (*Centaurea diffusa*).

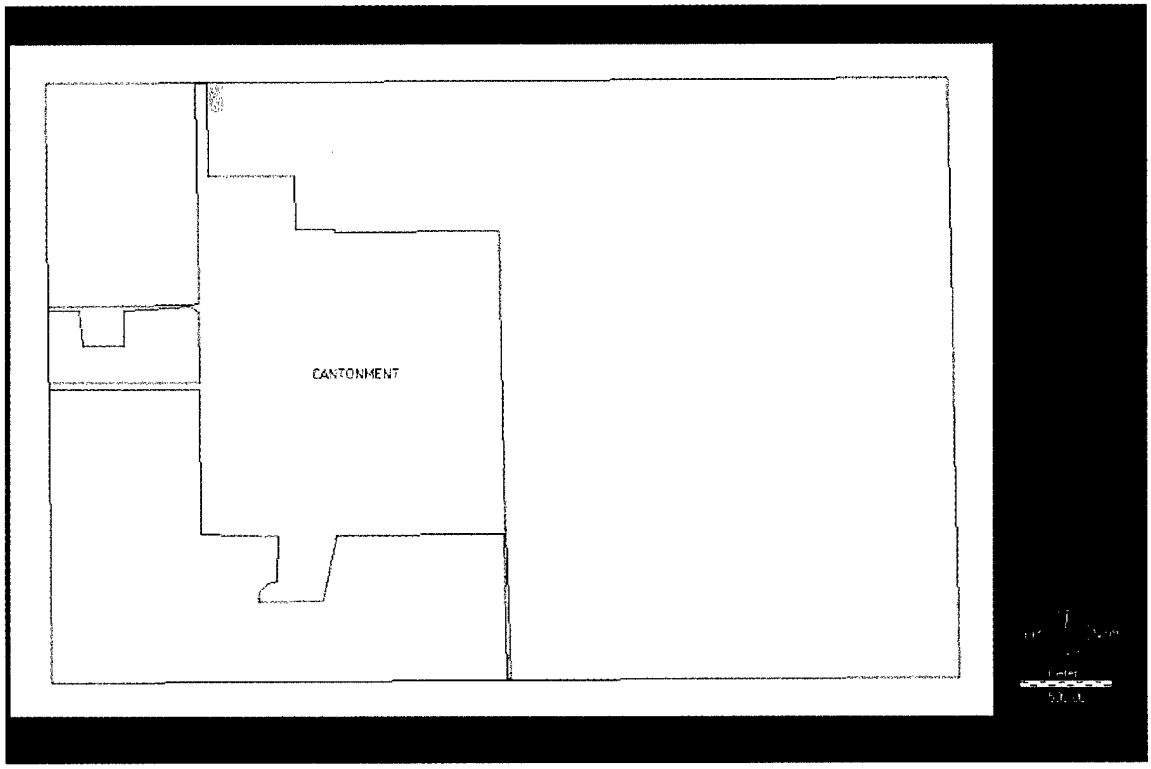

Figure 2. Population boundaries of diffuse knapweed (*Centaurea diffusa*). Pink areas mark the extent of populations.

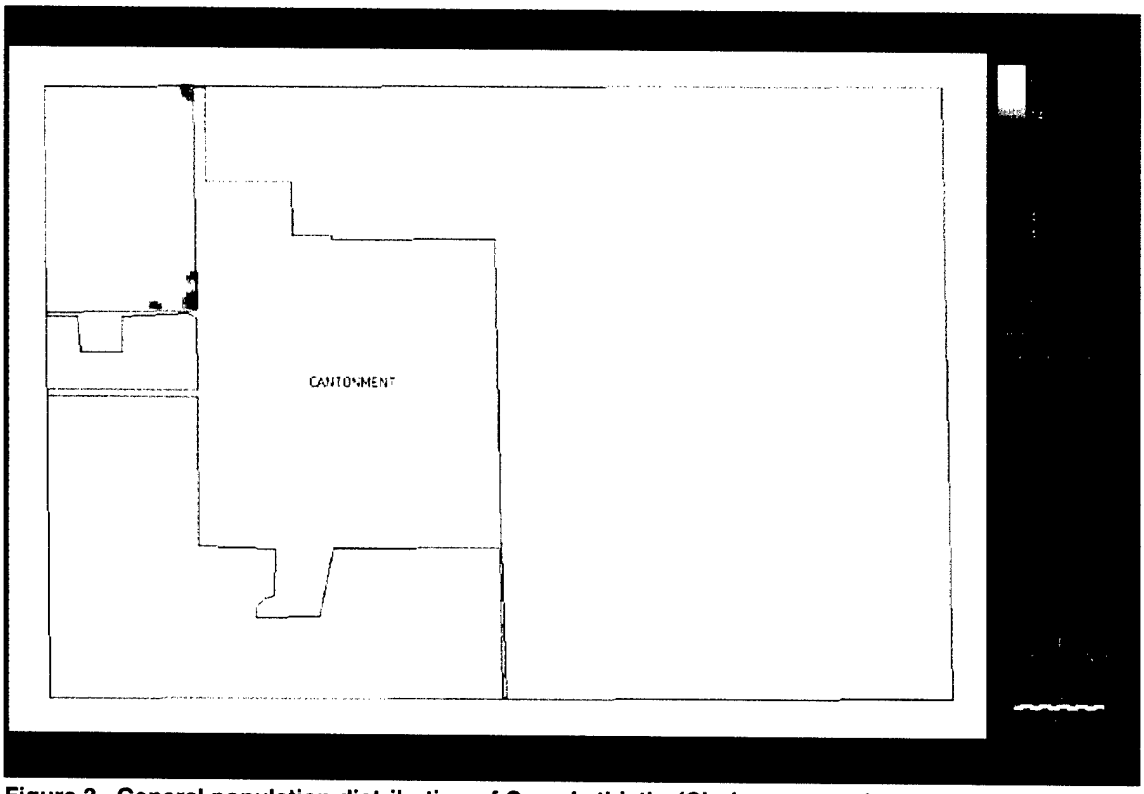

Figure 3. General population distribution of Canada thistle *(Cirsium arvense)*.

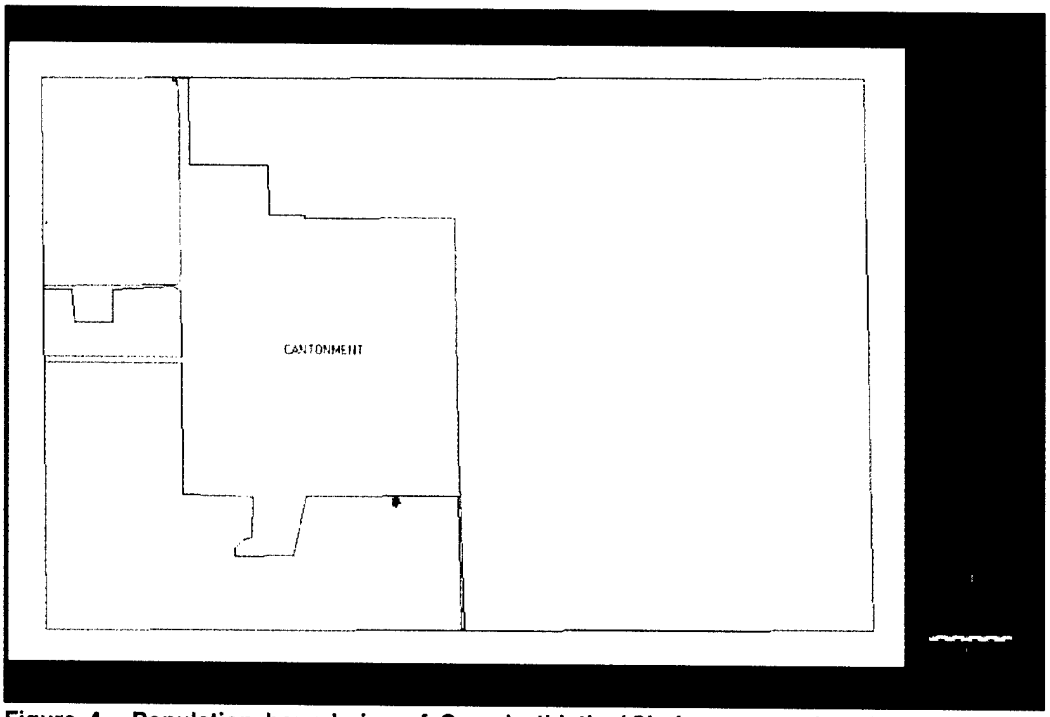

Figure 4. Population boundaries of Canada thistle (*Cirsium arvense*). Pink areas mark the extent of populations.

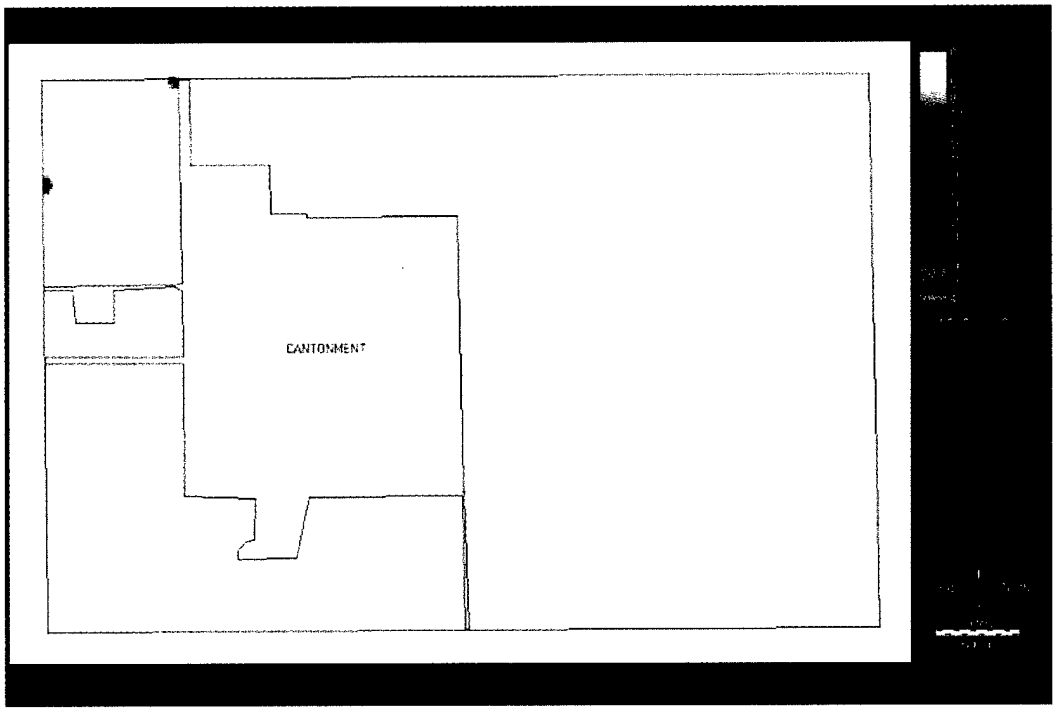

Figure 5. General population distribution of bindweed (*Convolvulus arvensis*).

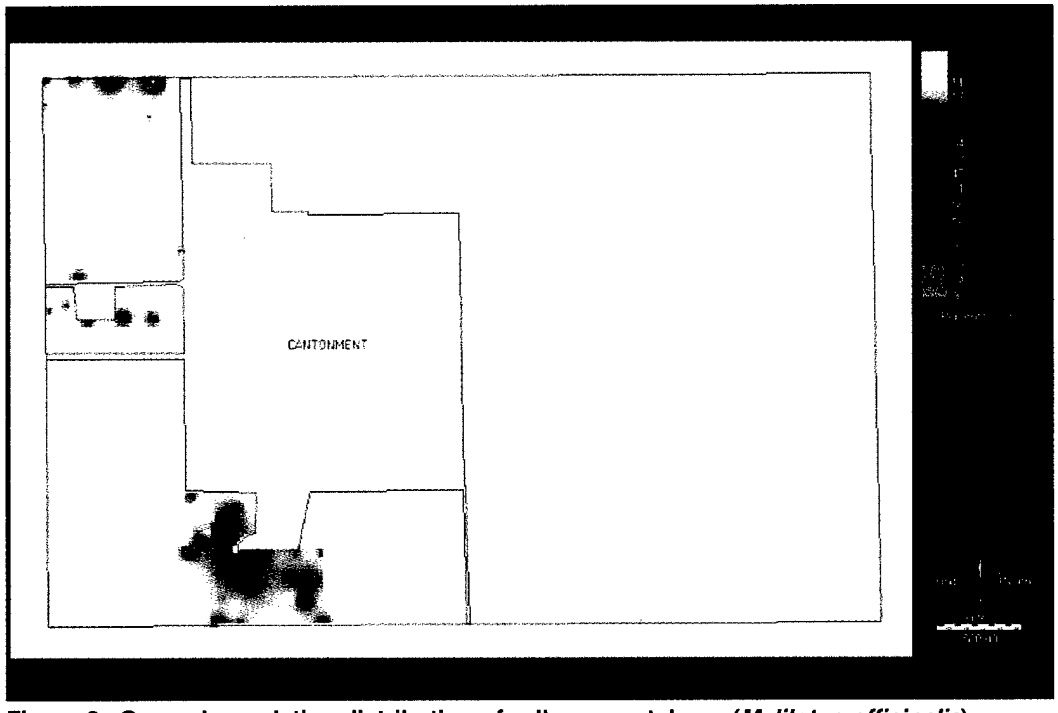

Figure 6. General population distribution of yellow sweetclover (*Melilotus officinalis*).

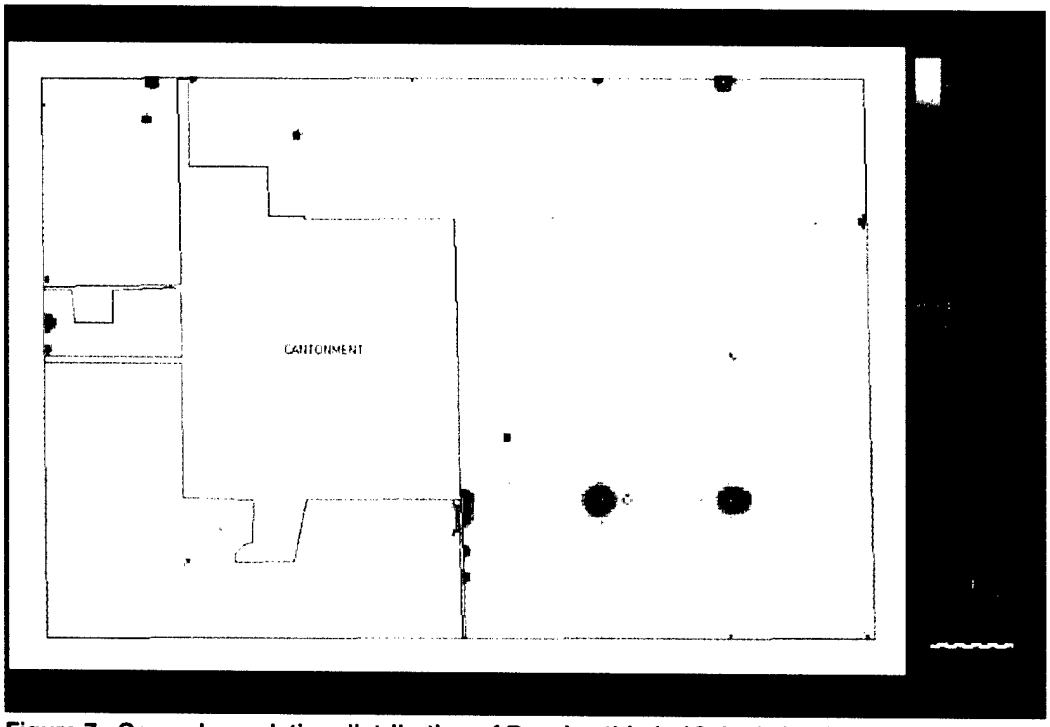

Figure 7. General population distribution of Russian thistle (*Salsola iberica*).

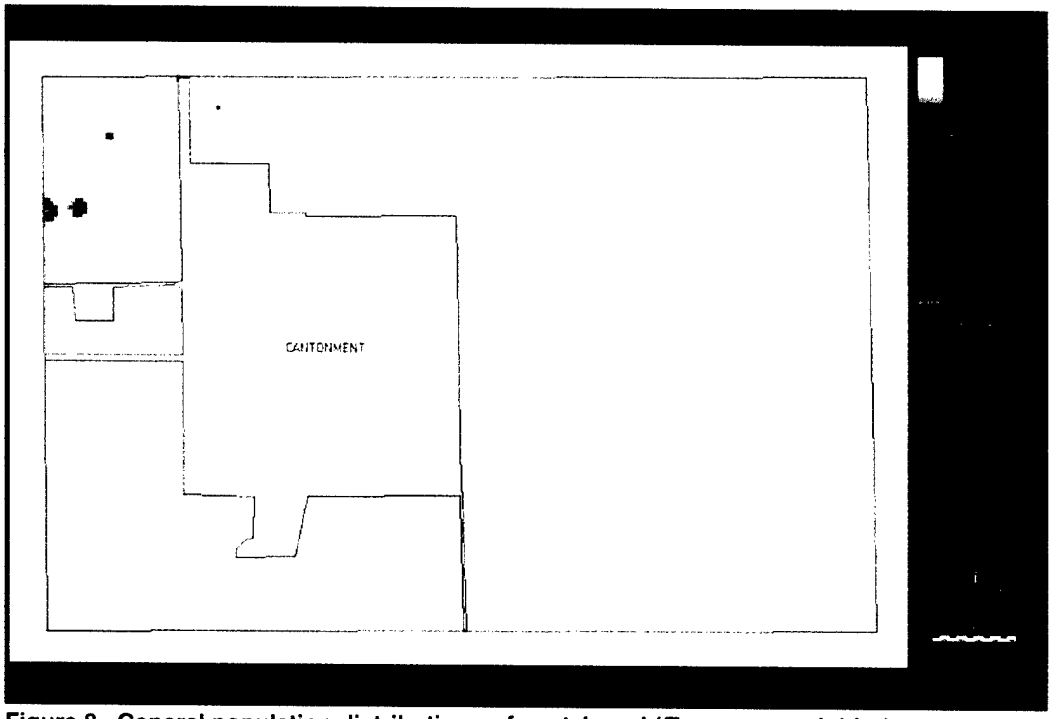

Figure 8. General population distributiuon of goatsbeard (*Tragopogon dubius*).

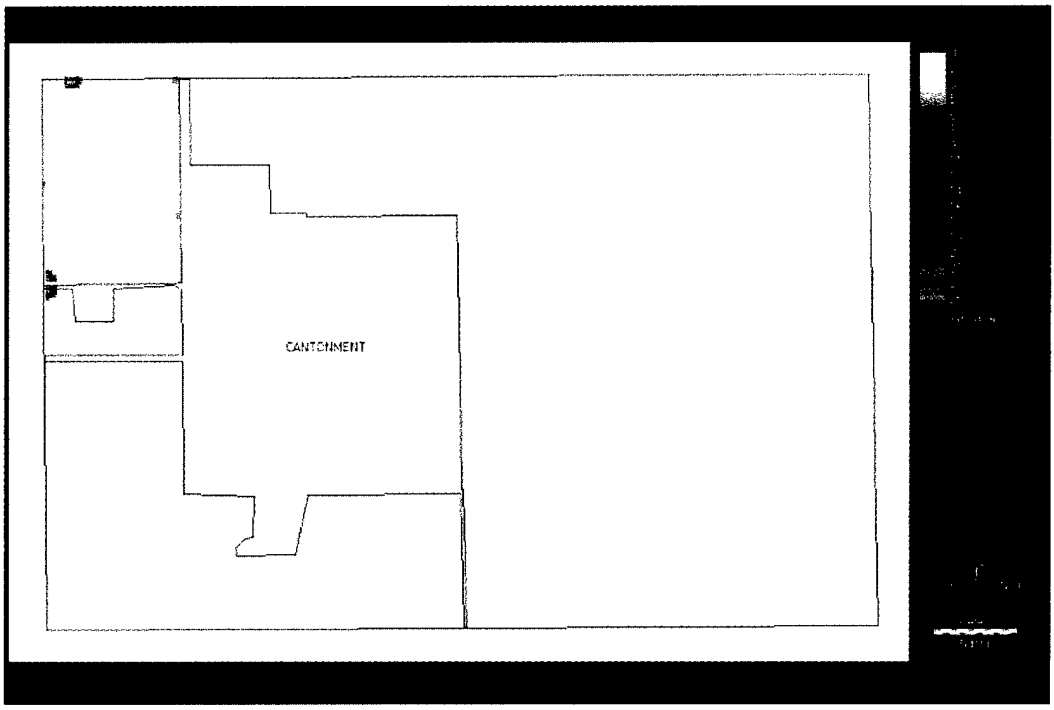

Figure 9. General population distribution of tumble mustard (*Sisymbrium altissimum*).

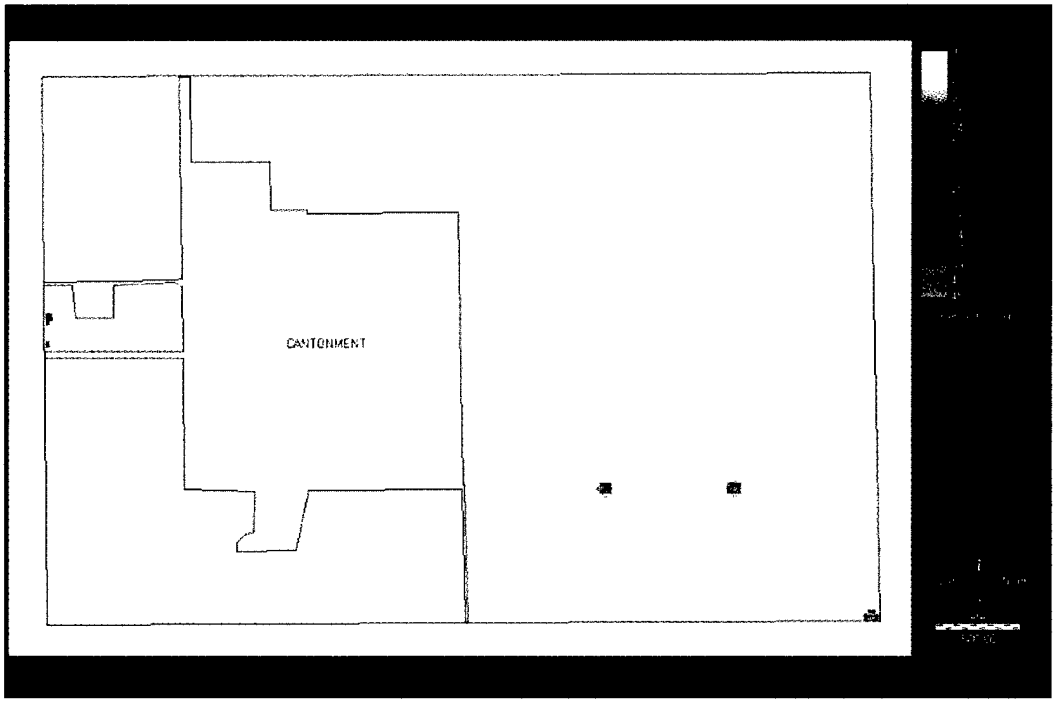

Figure 10. General population distribution of kochia (*Kochia scorpia*).

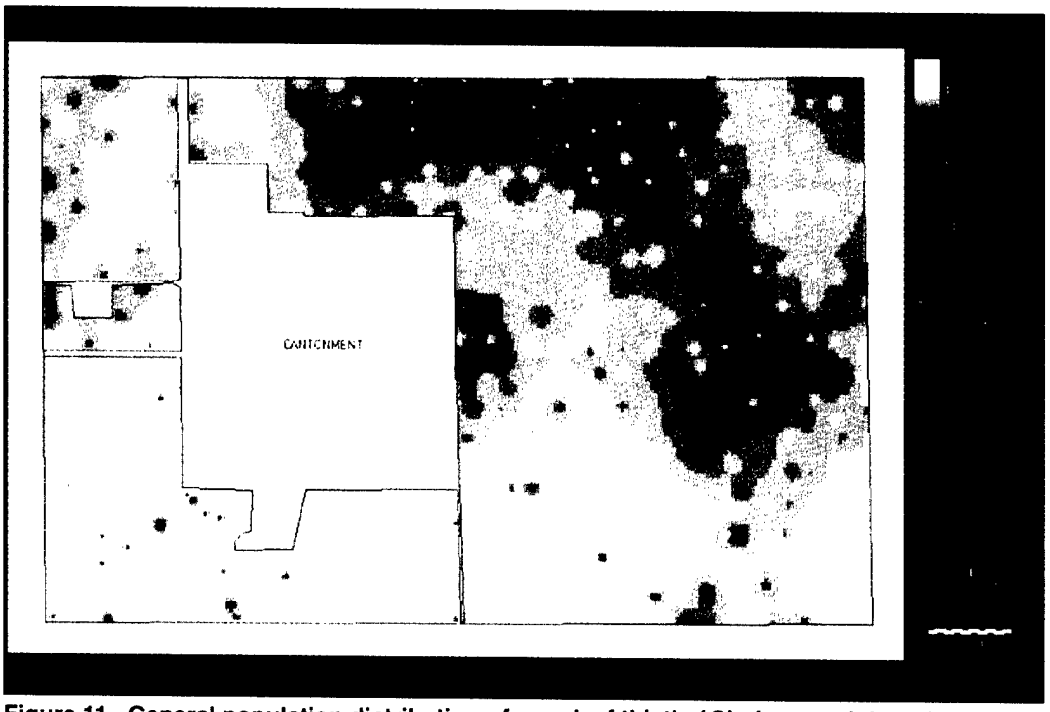

Figure 11. General population distribution of wavyleaf thistle (*Cirsium undulatum*).

4 Invasive Species Management Guidelines

The following paragraphs outline comprehensive control recommendations for management of diffuse knapweed and Canada thistle populations on Schriever AFB lands.

Diffuse Knapweed (*Centaurea diffusa*)

Diffuse knapweed is a diffusely branched annual or short-lived perennial. The general growth form is low and bushy, approximately 1 to 2 feet in height, with numerous white to rose-colored flower heads. Flowering usually occurs July through September. The weed colonizes disturbed areas (such as roadsides and land that is overgrazed), with the potential to exclude all competing species. A recommended field guide for identification of this species is *Weeds of the West* (Whitson et al. 1999).

A successful management plan for diffuse knapweed must include control methods and a comprehensive monitoring program. Effective control methods include biological, physical (i.e., burning, hand-pulling etc.), and chemical. Since Schriever AFB, like all DoD sites, needs to restrict pesticide use, it is recommended that control efforts be focused on physical methods.

Monitoring should occur in the spring, summer, and fall. Spring and summer surveys should focus on locating and eradicating mature plants. Fall surveys should focus on locating and destroying new established rosettes. Rosettes are the plant form the first year of growth, before the plant bolts to its mature bushy form. In addition to locating and destroying individual plants, the boundaries of populations should remapped and plant density should be estimated again to establish the effectiveness of management practices on a yearly basis.

Given Schriever AFB's need to restrict pesticide use and the limited extent of infestation (3.0 acres), it is recommended that individual plants be controlled using physical methods. Mature plants should be hand-pulled. Rosettes should either be hand-pulled or dug up.

If physical methods prove inadequate and herbicide use is necessary, Picloram (trade name: Tordon) has been shown most effective in controlling diffuse knapweed (Harris and Cranston 1979, Watson and Renney 1974, Beck 1997). Recommended application rates are 0.25 to 0.5 lb/acre; begin with lower rates and adjust upwards to obtain desired effects. Dicamba (0.5 to 1.0 lb/acre), 2,4-D (0.9 to 1.3 lb/acre), and Glyphosate (Roundup) are also effective in controlling diffuse knapweed. Weeds should be spot-treated to minimize herbicide use and reduce damage to desirable species. Monitoring and control practices should be maintained for 3 to 5 years in order to deplete the seedbank. Following seedbank depletion, annual monitoring is necessary to identify new infestations.

Other methods of control that can be used to supplement physical and chemical methods are seeding and burning. Crested wheatgrass (Agropryon cristatum) has been show to suppress diffuse knapweed populations through effective competition for soil moisture (Berude and Myers 1982). Crested wheatgrass is a naturalized exotic species; therefore, it may not be appropriate to introduce the species if non-native species are not desired. Fall burning can also be effective in controlling diffuse knapweed, although it is recommended that desirable species be reseeded afterwards to discourage knapweed reinfestation. These methods are more costly and should only be considered if physical and chemical methods are not producing satisfactory results.

Canada thistle (*Cirsium arvense*)

Canada thistle is a deep-rooted (up to 15 ft) perennial that primarily reproduces from roots (clones) and secondarily through seed. The general form is a 1- to 4-ft tall stalk with alternate, oblong to lancelet shaped leaves. Leaves have multiple lobes; each tipped with a spine. Flowers are purple and appear in July and August. A recommended field guide for identification of this species is *Weeds of the West* (Whitson et al. 1999).

Recommended management for Canada thistle includes both a control plan and a monitoring plan. Control should include herbicide application and mowing at Schriever AFB. These two methods combined have the most effective results in controlling Canada thistle. Monitoring should be conducted at least once a year with the following objectives: (1) determining the effects of current management, and (2) detecting new infestation. Monitor during the late summer through fall. Mapping colony boundaries is also recommended for documentation and management purposes.

Because the species goes through many growth stages throughout the year, each stage having differing susceptibility to herbicides, a multiseason application is most effective. Apply chemical controls in early spring (after last frost) and fall. Glyphosate (Roundup, Rodeo) applied as a spot treatment is recommended. Application rates can have varying effects due to environmental and biological factors. Literature shows rates of 0.4 lb/acre to 1.6 lb/acre are effective (Darwent et al. 1994). Initial application should be made at lower rates, with rate increases if effects are not acceptable.

Monthly mowing of thistle over several years (4+) has been shown to eliminate colonies without the need for herbicides (Welton, Morris, and Hartzler 1929); however this is probably not cost effective. Mowing in conjunction with herbicide use should occur at least three times a year at 2-week intervals. Mowing should be timed to occur just before seed set (mid to late summer). Mowing reduces the spread of seed and alters species growth stages, making them more susceptible to herbicides.

In addition to herbicide and mowing, native perennial grasses can be planted to augment weed control. Grasses will compete well with thistle and may be needed to replace desirable species destroyed by herbicides.

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14. ABSTRACT

For the natural resource/environmental office staff t Schriever Air Force Base (AFB), Colorado to better meet compliance and stewardship responsibilities regarding (1) invasive weed control within installation boundaries, (2) invasive weed impacts on stocking rates on agricultural out lease lands, and (3) DoD requirements for reduced pesticide use, they need detailed information to document the species, location, and density of invasive weed populations on the installation. This report provides documentation and maps for invasive/noxious weed populations on Schriever AFB. It also contains guidelines for management and control of diffuse knapweed (*Centaurea diffuse*) and Canada thistle (*Cirsium arvense*).

15. SUBJECT TERMS
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