CIENEGA CREEK NATURAL PRESERVE NON-NATIVE PLANT SPECIES STUDY

Project Report

April 2003

Pima Association of Governments

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CIENEGA CREEK NATURAL PRESERVE
NON-NATIVE PLANT SPECIES STUDY

INTRODUCTION

Background

Cienega Creek Natural Preserve (CCNP) is a 4,010 acre park located along Cienega Creek in eastern Pima County, Arizona. The Preserve extends for approximately 12 miles of stream length from Colossal Cave Road on the northwest to the former corners of the Empirita Ranch on the southeast. Approximately one half of the stream length exhibits perennial stream flow. CCNP is owned by the Pima County Flood Control District (PCFCD) and is managed by Pima County Natural Resources, Parks, and Recreation. Approximately 1,000 acres of riparian forest dominated by cottonwood, willow, and velvet mesquite exist in the preserve.

The Cienega Creek Natural Preserve Management Plan (McGann & Associates, 1994) states that there were three major management objectives established for the preserve. The second objective was to protect the existing natural riparian community of the preserve. Non-native species pose multiple threats to the native riparian plant community found in the preserve. Additionally it was stated that CCNP will be managed with the objective of preserving, protecting and enhancing the existing native vegetation of the preserve with the greatest emphasis given to protecting and restoring the native riparian woodlands and other areas of riparian vegetation. The following policies were enacted by the CCNP Management Plan: 1) The introduction of non-native plant species shall be prohibited; 2) To the extent feasible, non-native plant species such as tamarisk that threaten to displace native plant species shall be monitored and, if necessary, controlled or removed from the Preserve.

Purpose

The purpose of this study was to identify the non-native species that have been successful at invading the Cienega Creek Natural Preserve and to suggest management actions to remove the threats caused by these non-native species. To the extent possible in the scope of this project the location and extent of the non-native species population was determined.

METHODS

Literature Review and Interviews

In anticipation of the field work for this project, PAG contacted several local land managers to determine which invasive non-native species pose the biggest threat to the CCNP region.

Mark Holden, a land manager at Saguaro National Park – East, was contacted via email and in person at a meeting of the Pima Invasive Species Council. He suggested that the species that he thought could be problematic in riparian areas were saltcedar (*Tamarix chinensis*), African sumac (*Rhus lancea*), and fountain grass (*Pennisetum setaceum*). He also suggested that in perennial reaches, the aquatic species Giant salvinia (*Salvinia auriculata*) and hydrilla (*Hydrilla verticillata*) might be problematic. He added that Buffelgrass (*Pennisetum ciliare*) has been problematic in the upland areas of Saguaro National Park East.

Linda Kennedy, a scientist at the National Audubon Society's Appleton-Whittell Research Ranch was contacted on a Pima Invasive Species Council Field Trip to the Appleton-Whittell Research Ranch. The majority of the Research Ranch's non-native species control efforts had been directed at the removal of Lehmann lovegrass (*Eragrostis lehmanniana*) and Boer lovegrass (*E. curvula*). She suggested eradication methods that had worked at the Research Ranch for the non-native lovegrasses. She also offered that she had observed a stand of blue panic grass (*Panicum antidotale*) for several years and had not observed it to spread.

Keith Hughes, a Natural Resource Specialist with Bureau of Land Management in charge of weed management for the Las Cienegas National Conservation Area, was contacted via telephone. He responded via email that the species that he is concerned about in the areas upstream of CCNP are Lehmann lovegrass and saltcedar. He also referred PAG staff to the Weed Management section of the Draft Las Cienegas Resource Management Plan and Environmental Impact Statement.

To supplement the information gathered from personal contacts a literature and internet review was conducted. The literature review was conducted at the University of Arizona using the Science Citation Index and the general library catalog. General web searches for information on specific species as well as information on non-native species were conducted using the "Google" search engine.

A map was created to determine the pattern of land ownership in the lands surround CCNP (Plate 1). The Pima County Land Information System, Version 19 parcel base shapefile was modified and land ownership was classified by the Arizona State Land Department land use codes. The potential of invasion from

new non-native species and the potential for cooperative agreements to remove non-native species populations vary with surrounding land ownership and land uses. This map shows that the majority of land bordering CCNP is under the jurisdiction of the Arizona State Land Department with additional parcels being owned by development interests, ranching concerns, and the Bureau of Land Management.

Field Methods

Seven individual trips were taken to Cienega Creek Natural Preserve by PAG staff in 2001 and 2002. Dates included September 9, 2001, October 10, 2001, November 6, 2001, March 3, 2002, July 7, 2002, September 9, 2002, and October 3, 2002. Most field visits were made during or soon after the monsoon season when most perennial species (especially grass species) would be most easily identified.

Field surveys were focused on linear features in the landscape at CCNP. Such features included roads (Interstate 10, Marsh Station Road, and numerous unpaved roads), Union Pacific Railroad's eastbound track, utility right-of-ways, trails and stream-courses. Linear features are known to help distribute propagules of non-native species as they act as corridors for animals, people, and vehicles which have the potential to serve as vectors for the dispersal of plant species (Moore and Gerlach, 2002). Often both the natural and manmade linear features are subject to more frequent disturbance (mostly flooding for stream-courses, ground disturbance in manmade features) than surrounding areas, also making these areas more susceptible to invasion by non-native species. Additionally, PAG staff attempted to conduct surveys for invasive species in each of the different upland and riparian habitat types found in CCNP.

Field surveys were conducted by visual inspections. When populations of non-native plant species were encountered, the location of the population was either located and marked on aerial photographs or marked electronically using a Magellan ColorTRAK Global Positioning System Unit. Information for each location was hand recorded and included species present (both native and non-native) and size and extent of the non-native population. Digital and film photographs were taken of the weed infestations on several of the survey days. An ArcView shapefile was created to hold the data collected during the surveys. Data fields in the shape file include weeds present at each location, date of survey, weed population size and extent, and comments . Also longitude, latitude and elevation from the GPS readings are included. Additionally information on the location of additional non-native species populations from previous PAG field trips to CCNP and communications with PCFCD staff was then added to the ArcView shapefile. The resulting shapefile is displayed on Plate 2.

When populations of unknown species were encountered during surveys, their locations were marked as above, and flowering samples of the species were collected for identification. These specimens were identified by PAG staff using the resources of the University of Arizona Herbarium. Sample identification of the grass species (Family *Poaceae*) were confirmed by Charlotte Reeder and John Reeder, who are specialists in Arizona grass species.

Additionally information from a previous PAG field trip on June 12, 2000 and communications with PCFCD staff about the location of additional non-native species population locations were added into the ArcView shape file.

SUMMARY OF RESULTS

Sixteen non-native plant species were found in the surveys for this study (Table on Plate 2). Grass was the most common growth form with three species of annual grass (red brome, jungle rice, and stinkgrass) and eight perennial species (giant reed, Bermudagrass, Lehmann lovegrass, Wilman lovegrass, rose natal grass, blue panic grass, buffelgrass, and Johnson grass) identified in the surveys. The history of the deliberate introduction (in both the CCNP region and the preserve itself) of grass species for range improvement for cattle grazing was responsible for at least six species of grass (Bermudagrass, Lehmann lovegrass, Wilman lovegrass, blue panic grass, buffelgrass, and Johnson grass) identified during the survey. Four species of herbaceous species were found during the surveys, of which two were annual species (Russian thistle and London rocket) and two were perennial (watercress and periwinkle). A single woody non-native species (saltcedar) was identified in the surveys. Only five of the identified species were annual species, and populations of those species were quite small. The winters during the survey period were characterized by lack of precipitation, and many non-native species present in the Sonoran Desert region are of European origin. These act as winter annuals and are dependant on abundant winter rainfall. Therefore the dry winters during the survey periods may have caused an under-representation of annual species in the surveys conducted for this study.

Four of the species discovered during the survey can be said to have naturalized into the preserve and are found in most of the habitats in which the species can survive. These species are Bermudagrass, Lehmann lovegrass, watercress, and Johnson grass. Eradication of these species would be difficult because of the degree to which they are integrated into the ecosystem. These species have all successfully invaded most suitable areas throughout southern Arizona, if not most of the warm areas of the United States. Saltcedar has naturalized into most available habitats throughout southern Arizona, however populations of saltcedar in CCNP are small and not dense. It is not known if saltcedar is increasing in density, basal area, or percent of vegetative cover in CCNP. Currently saltcedar populations in CCNP could be eradicated with moderate effort and expense. Buffelgrass and giant reed populations could possibly expand greatly from their

current levels, which are quite small. Both species are excellent candidates for eradication; however, especially in the case of buffelgrass, chances for re-infestation would be great. Therefore frequent monitoring of road and railroad areas would be necessary to keep the preserve free of these grasses once they are eradicated.

Several species have very limited distributions within the preserve, making the eradication of these species considerably easier. The small and extremely localized population of periwinkle would be a good candidate for eradication. However, it is located in a remote location which complicates the removal. The potential for spread of that population is small, due to the fact that periwinkle does not reproduce by seeds in southern Arizona, only vegetatively. Blue panic grass is another species that has a limited distribution in the preserve. It appears to have been planted in the area of the Cienega Well[1]. One large stand covers a nearly two-acre patch. Comparing aerial photographs taken in 1996 to conditions during the surveys, this stand does not appear to have spread. Due to the concentrated nature of the blue panic grass populations, eradication of this grass could be obtained by mechanical or chemical means with a medium amount of effort.

Eradication of the annual nonnative species (red brome, jungle rice, stinkgrass, red star, Russian thistle, and London rocket) is difficult due to the fact that not all viable seeds of these species germinate every year. Additionally the short period between germination and seed production makes the discovery of populations to control unlikely. The difficulty of control makes control of the annual species a low priority.

MANAGEMENT SUGGESTIONS (in order of importance)

1) Hand remove buffelgrass from shoulders of Marsh Station Road.

2) Obtain permission from Union Pacific Railroad to hand remove the population of buffelgrass found outside the preserve that occurs in the Union Pacific Railroad right-of-way.

3) Remove large clump of giant reed from Empirita Ranch Headquarters section of CCNP.

4) Make contact with developers of major projects near CCNP (for example the housing development surrounding the Del Lago Golf Course) and try to discourage the planting of non-native vegetation (for example African Sumac which has not shown up in the preserve but has the ability to invade the same habitats that saltcedar does and is widely planted in the Tucson area).

[1] Location of the Cienega Well is found in Pima Association of Governments (1998).

5) Re-vegetate large disturbed areas in the preserve to natural vegetation. Candidates for revegetation include retired agricultural fields near the caretaker's residence (North of Interstate 10), the pastures near the Empirita Ranch Headquarters and the areas previously used for material storage in the section of the preserve directly south of Interstate 10.

6) Maintain contact with the Weed Management Specialist at the Arizona State Land Department (ASLD), because the majority of lands bordering the preserve are owned by the ASLD. ASLD also manages a good deal of land upstream of CCNP, and cooperating with weed removal upstream may prevent future introductions of species to CCNP. For the same reason the County should maintain a dialogue with the weed management specialist for the Bureau of Land Management Las Cienegas National Conservation Area.

7) Contact Jack DeLoach at the United States Department of Agriculture, Agricultural Research Service Grassland, Soil and Water Research Laboratory, in Temple, Texas, to investigate the suitability of a bio-control release to reduce tamarisk in CCNP. This should be coordinated with upstream land managers (BLM and Arizona State Land Department) to reduce potential input from upstream populations as well as removing current populations.

8) Begin a tamarisk removal program starting from the upstream portions of the preserve, first concentrating on the areas south of Interstate 10 and in Davidson Canyon. While there have been suggestions (Stromberg, 1998; Everitt, 1980) that tamarisk will not become more prevalent than it already is in the preserve, the relatively low densities of tamarisk make removal of the species more feasible currently, than in the future if the population in the preserve increases.

9) Eradicate the large blue panic grass population northeast of the Cienega Well and restore the mesquite bosque in its place.

NON-NATIVE SPECIES FOUND IN CIENEGA CREEK NATURAL PRESERVE

Giant Reed
***Arundo donax* L.**

Origin
Mediterranean

Description
Giant reed is one of the largest grasses in the world, attaining heights of up to 30 feet. It grows mostly in moist places, such as ditches, streams, and seeps (Bell, 1997). It grows best in well drained soils along river banks, especially in areas where water tables are close to or at the soil surface (Hoshovsky, 1986). Giant

reed can be set back by drought in the first year after establishment, however after two or three years clonal clumps of giant reed are relatively unaffected by drought (DiTomaso, 1998).

Status of Cienega Creek Populations

One clump was removed by PCFCD personnel from a side drainage on private property north of the creek. This site has not been revisited after removal (D. Scelero, PCFCD personal communication). A large clump was located during the October 3, 2002 survey date on the Empirita Ranch Headquarters section of the preserve. This population of *Arundo donax* is photo-identifiable on aerial photography from 1992 (USGS Digital Orthophoto Quarter Quadrangle, The Narrows). The population did not to appear to have changed greatly in size or density from 1992 to 2002.

Species Ecological Profile

Giant reed can grow quickly and cast dense shade allowing it to out-compete and suppress most native vegetation. The clonal natural of giant reed allows it to form pure stands (Zohary and Willis, 1992). Seeds of giant reed in California are seldom viable (Bell, 1993). Giant reed therefore spreads most commonly vegetatively. Flood events in riparian systems break up clumps of giant reed and spread the root fragments downstream where they take root and establish more clones (Bell, 1997).

Control Methods

Areas infested with giant reed can be restored to native vegetation; however, since growth of giant reed is mostly through rhizome fragments, the entire rootstock must be removed to eradicate an infestation. Bell (1997) suggests a systemic herbicide application at an appropriate time of the year to ensure translocation to the roots of the plant. Rodeo®, a tradename formulation of glyphosphate, has been approved for use in wetlands by the EPA and has been shown to be effective in control of giant reed (Finn and Minnesang, 1990; Jackson, 1993; US Department of Agriculture, 1993). The most effective application of Rodeo on giant reed is a foliar application of 2-5% solution of Rodeo® during the post-flowering and pre-dormancy season (approximately mid-August through early November) at a rate of 0.5 to 1 L/hectare (Bell, 1997). Cut stem treatment with Rodeo® is also a successful control measure (Monsanto, 1989) but due to the amount of labor necessary and the fact that the cut stems can produce roots and need to be chipped makes this method often more costly than the foliar spray technique. The benefit of this method is that less herbicide is necessary for control of the giant reed (Bell, 1997).

Red Brome
***Bromus rubens* L.**

Origin
Mediterranean

Description
Red brome is a short (20 cm to 50 cm) cool-season annual bunchgrass.

Status of Cienega Creek Populations
Red brome is found scattered throughout upland and riparian habitats in CCNP. Germination of red brome from the seedbank is most prevalent after wet winter periods. Throughout the survey period, winter rainfall was almost non-existent; therefore, germination of red brome was minimal during the time of PAG's field investigations and red brome could be more prevalent in CCNP. McGann & Associates (1994) observed that stands of red brome were dense on fertile terraces adjacent to the creek.

Species Ecological Profile
Red brome is a winter annual in Arizona. Germination of red brome seeds is dependant on the moisture level in the soil. Vegetative growth (and therefore total red brome biomass) is independent of precipitation after germination has occurred. Red brome is a relatively weak competitor, due to its low shade tolerance and relatively shallow root system, and cannot compete with established plants (Hufstader, 1976). However, red brome has the ability to out compete native Mohave desert winter annuals by requiring less moisture for germination, thus red brome germinates faster, allowing it to shade seedlings of the natives (Beatley, 1966).

Red brome is also extremely fire adapted, and fire actually increases red brome densities in the next growing season. Red brome also changes the dynamics of fire in Sonoran desert uplands by providing large amounts of fine fuel, allowing fires to spread into areas where native vegetation would not allow the fire to spread. This causes the death of native vegetation not adapted to fire (Asher, 2002).

Control Methods
Mechanical control methods (for example howing or hand-pulling) can keep red brome from reaching maturity, thus ensuring that no new red brome seeds are added into the seed bank. This task would have to be repeated over several years, as red brome seeds germinate over a long period of time (Newman, 1992a).

Due to the annual growth cycle of red brome, the most effective chemical control would be from pre-emergence herbicides. Such herbicides are broad spectrum

and would eliminate the native annual species as well as the red brome, and would be unsuitable for most conservation purposes.

Management Priorities
The scattered populations of red brome that were found in the surveys suggest that the species is not as problematic in CCNP as it is in other areas in the Sonoran Desert. However, if the extensive stands that were noted in McGann and Associates (1994) redevelop, the species would be considered more problematic due to the propensity of red brome to carry fires. Control of the species is also difficult due to its annual growth form. The majority of control efforts should be to prevent new infestations by maintaining or enhancing natural plant cover.

Bermuda Grass
***Cynodon dactylon* (L.) Pers.**

Origin
East Africa

Description
Bermuda grass is a perennial, warm-season grass. It is a turfgrass species spreading by both rhizomes and solons.

Status of Cienega Creek Populations
Bermuda grass is found throughout bottomland habitats in Cienega Creek Natural Preserve. It is very common along stream banks along perennial, intermittent, and ephemeral reaches of the stream. The understory in mesquite bosque habitats is often dominated by Bermudagrass. It has been reported that Bermuda grass was planted along Cienega Creek in the early 1900's for erosion control (McGann and Associates, 1994).

Species Ecological Profile
Bermuda grass is a warm-season turfgrass that spreads by rhizomes and stolons. This allows for rapid expansion of patches. It is extremely drought tolerant. Bermuda grass tolerates a wide range of soil types and conditions but grows best in clay soils under dry conditions (Newman, 1992b).

Bermuda grass has a great ability to spread rapidly. This fast growth rate allows Bermuda grass clones to utilize a vast area for uptake of water and nutrients. The varieties of Bermuda grass found in the southwestern United States also produce many viable seeds. The seeds maintain viability after passing through the intestinal tract of livestock and also can survive submergence in water for up to 50 days. Another characteristic of Bermuda grass that makes it a superior competitor are its allelopathic qualities. It has been shown that root growth and

seedling germination of other species are inhibited by both decaying biomass and actively growing plants (Newman, 1992b).

Bermuda grass is also continually planted throughout southern Arizona for many purposes including lawns, golf course greens, and for irrigated pasture lands.

Control Methods
Control of Bermuda grass is difficult without the use of herbicides. Multiple repeated tilling and herbicide treatments are usually necessary to remove all the existing Bermuda grass stolons and rhizomes prior to restoration efforts, along with many years of spot herbicide treatments until the Bermuda grass is removed or total ground cover is obtained by preferred species (Newman, 1992b). Linda Kennedy (personal communication) reported that Audubon personnel have had some success controlling the 'Coastal' variety of Bermuda grass at the Research Ranch by applying glyphosphate to the actively growing portions of stand of the grass.

Management Priorities
Bermuda grass is naturalized into the CCNP ecosystem. It would be a difficult species to remove because of the large size of clonal patches of the grass, the difficulty in removing all of the underground roots of a patch which will resprout, and the constant input of new individuals from many sources outside of the preserve. It is not believed that the Bermuda grass will invade new habitats in CCNP. It is not believed that effective control of Bermuda grass could be obtained for CCNP, so Bermuda grass should be placed in the low priority list of species for control.

Jungle Rice
***Echinochloa colona* (L.) Link**

Origin
Eurasia

Description
Jungle rice is a spreading annual grass, 2/3 to 2 or 3 feet high. The stems are spreading and prostrate, often rooting at the base, then ascending. Early in growth it forms a dense rosette of leaves at the ground level (Ruyle and Young, 1997).

Status of Cienega Creek Populations
One population of jungle rice was found in the vicinity of the Cienega Well. The population was probably established by use of the site as a paddock area.

Species Ecological Profile
Jungle rice can be a nuisance weed in crops, turf, and other irrigated areas in Central and Southern Arizona (Ruyle and Young, 1997).

Control Methods
Jungle rice has developed herbicide resistance (International Survey of Herbicide Resistant Weeds, 2002). As with most annual species the most effect control method is to obtain a canopy of native perennial plants that will inhibit the growth of annuals.

Management Priorities
Management of jungle rice is a low priority. The population in CCNP is small and limited, and in the absence of disturbance that was once provided by cows is not believed to spread. If native perennial grasses are established in the area it is believed that the jungle rice population would not persist.

Stinkgrass
***Eragrostis cilianensis* (All.) Vign. ex Janchen**

Origin
Europe

Description
Stinkgrass is a summer annual grass weed that emits a distinctive odor. It grows to two feet in height. The inflorescence is an open panicle with several flowered spikeletts that appear large in comparison to the leaves.

Status of Cienega Creek Populations
A small population of stinkgrass was found near the Empirita Ranch Headquarters area.

Species Ecological Profile
Stinkgrass is a warm season annual grass. It is found in open ground and disturbed areas and may form pure stands in swales where runoff accumulates. It is considered a weed in cultivated fields (Coronado RC&D, ND).

Control Methods
No information on the control of stinkgrass could be located, but as with most annual species the most effect control method is to establish a canopy of native perennial plants that will inhibit the growth of annuals.

Management Priorities
Control of stinkgrass is a low priority because of its annual growth form and low comparative level of threat posed by the species. Development of a canopy of native vegetation would effectively control this species.

Lehmann lovegrass
***Eragrostis lehmanniana* Nees**

Origin
Africa

Description
Lehmann lovegrass is a fine textured warm season perennial bunchgrass. It grows to approximately two feet in height. During the growing season the plant is bright green in color, in the winter it cures to a dull yellow. The inflorescence is 3 to 6 inches long and is open, spreading, and appears quite delicate (Ruyle and Young, 1997).

Status of Cienega Creek Populations
Lehmann lovegrass is ubiquitous in the uplands of CCNP. It is the dominant grass species found in these areas.

Species Ecological Profile
Lehmann lovegrass is a superior competitor to most native grasses. It has been proved to be the grass best adapted to reseeding in southern Arizona (Ruyle and Young, 1997). It has been known to replace native grasses without disturbance (U.S. Department of Agriculture, 2002a). It was brought to the United States to improve range conditions as well as to seed highway right-of-ways and mine reclamation areas (Coronado RC&D, ND).

It has been shown that both animal and plant diversity is lower in stands of Lehmann lovegrass as compared to stands of native grasslands. However, populations of Hispid cotton rat and Botteri's sparrow were more abundant in stands Lehmann lovegrass and Boer Lovegrass than in native grasslands. This is presumed because the non-native lovegrasses mimic sacaton grasslands preferred by these species (Bock and Bock 2000). Cattle will graze Lehmann lovegrass mostly early in the spring and late in the fall when it is green and most other species have already cured. In other times cattle will prefer native species to Lehmann lovegrass (Ruyle and Young, 1997).

Control Methods
At the National Audubon Society' Appleton-Whittell Research Ranch near Sonoita Arizona, control of Lehmann lovegrass has been obtained by the combination of a controlled burn and the backpack application of glyphosate

during the resprouting of the Lehmann lovegrass. Control has also been obtained at the Research Ranch by glyphosate application alone. Chemical control at the Research Ranch has been very labor intensive (Linda Kennedy, National Audubon Society Appleton-Whittell Research Ranch personal communication).

Management Priorities
Management of Lehmann lovegrass in CCNP is a low priority because of the immense effort required to eradicate the species.

Wilman lovegrass
***Eragrostis superba* Peyr.**

Origin
South Africa

Description
Wilman lovegrass is warm season perennial bunchgrass. It grows to a height of about three feet from a moderately vigorous and sparsely branched base. Leaves and stems are light green when growing and cure to a light yellow. Inflorescences are born at the end of erect stems and are six to ten inches long. The individual spikeletts are quite large, flattened, ornamental and somewhat resembling rattlesnake rattles (Ruyle and Young, 1997).

Status of Cienega Creek Populations
One population of Wilman lovegrass was found on the preserve, along the Well Access Road[2]. It appears that the species was planted to stabilize the road after it was abandoned after the establishment of the preserve. The population is small and does not appear to have spread far from its initial planting location.

Species Ecological Profile
Wilman lovegrass is relatively easy to establish. However, it fails to persist in rangeland (Texas Cooperative Extension, 2002). It is extremely palatable, especially to rabbits, which leads to its inability to persist under grazing. It does not survive where temperatures drop below 10-15 degrees Fahrenheit and does not prosper with less than 14 inches of rain per year (Ruyle and Young, 1997).

Control Methods
No information was found on the control of Wilman lovegrass.

Management Priorities
Control of Wilman lovegrass is a low priority. The species does not appear to be invading new habitats in CCNP.

2 Location found in McGann and Associates (1994).

Rose Natal Grass
***Melinis repens* (Willdenow) Zizka**

Origin
South Africa

Description
Rose Natal grass is a perennial bunch grass that grows to 3 feet in height.

Status of Cienega Creek Populations
Rose Natal grass is known from a single population at CCNP from the floodplain of Cienega Creek downstream of the Marsh Station Road crossing of the creek.

Species Ecological Profile
The earliest discovery of Rose Natal grass in Pima County was in 1939 (Kearney and Peebles, 1960). It has also been found in Saguaro National Park and Catalina State Park (Connolly, 2000). It is also a common roadside weed in the Mexican state of Sonora, and has become invasive in desert grassland south of Nogales, near Maycoba in the Sierra Madre Occidental, and the mountains north of Guaymas (Van Devender et al., 1997). Rose Natal grass is listed a Category II invasive species in Florida, meaning that it is a species has the potential to disrupt native plant communities, but has not disrupted a native plant communities in Florida (Florida Exotic Pest Plant Council, 2001). It has been described in Australia as a effective competitor against native species, reducing habitat diversity (Water and Rivers Commission, 2001).

Control Methods
Rose Natal grass is considered to be relatively easy to control. In the young 3- to 5-leaf growth stage, a 1 liter per hectare formulation of Fusilade (a grass-specific herbicide produced by Syngen) provides control, while for mature plants a 4 liter per hectare formulation of Fusilade is needed for control. In Australia, the best time to spray is between June and August (corresponding to December through February in Arizona) (Water and Rivers Commission, 2001).

Management Priorities
Little is known about Rose Natal grass in southern Arizona. It has been present in Pima County for a long period of time and has not become a major invader of habitats, but is known in other areas to be a successful invader. Therefore the species should be monitored in CCNP, so that action can be taken to eradicate the species if it is found invading new areas in the preserve.

Blue Panic Grass
***Panicum antidotale* Retz.**

Origin
India and Afghanistan

Description
Blue panic grass is a vigorous warm season perennial bunch grass that has stems that reach up to 7 feet in height. It has an extensive root system and short, thick bulbous rhizomes. The inflorescence is loose and open, 8 to 12 inches long, and erect to slightly drooping (Ruyle and Young, 1997).

Status of Cienega Creek Populations
It is believed that the populations of blue panic grass were established by planting when the preserve was an active cattle ranch. It is also believed that the horticultural variety of the species is "A-130", a 1950 release of the Tucson Plant Materials Center of the Natural Resource Conservation Service (previously Soil Conservation Service) (U.S. Department of Agriculture, 2002b). The area where the species was planted is in the vicinity of the Cienega Well, to the southeast of the Well Access Road. There is an approximately 2 acre clearing in the mesquite bosque that is almost a monoculture of blue panic grass. Other smaller stands are also found in this area. It is not known if the species is increasing or spreading in the preserve.

Species Ecological Profile
The invasiveness of blue panic grass in southern Arizona has been noted as aggressive (Jim Horsley, Arizona Department of Transportation personal communication) or not spreading (Linda Kennedy, National Audubon Society Appleton-Whittell Research Ranch personal communication). It has been noted to persist under grazing (Ocumpaugh and Stichler, 2000). Blue panic grass is best adapted to medium to fine textured alluvial soils where either irrigation or frequent flooding occurs (US Department of Agriculture, ND). The species is listed as a noxious weed in the state of California (US Department of Agriculture, 2002c).

Control Methods
There is very little written about control methods for blue panic grass. More information has been written about how to propagate and maintain the species (US Department of Agriculture, ND, Ocumpaugh and Stichler, 2000, and Ruyle and Young, 1997). The only suggestion found on control methods was that methods for control of Johnson grass should also work on blue panic grass (California Department of Food and Agriculture, 2002).

Management Priorities
It is not known if the population of blue panic grass at CCNP is actively spreading. If it is spreading, it appears that the rate of spread is relatively slow.

The species has a very localized population in the preserve, which would facilitate eradication efforts. The population should be monitored to determine if it is in fact spreading. If it is found to be invading new areas then the species should become a top priority for control efforts. If the species is not found to be invading new areas then its control priority is only moderate. It should be noted that when control is attempted, re-vegetation afterwards is necessary to prevent new populations of different non-native weeds, because blue panic grass provides almost 100 percent cover in the areas where it occurs.

Buffelgrass
***Pennisetum ciliare* (L.) Link**

Origin
Africa

Description
Buffelgrass is a warm season perennial bunchgrass. It grows to approximately 2 ½ feet in height. The inflorescence is cylindrical in shape, can be from one inch to six inches in length, and is characteristically purple-ish in color.

Status of Cienega Creek Populations
Three separate populations of buffelgrass were found in the surveys conducted for this report: on the shoulders of Marsh Station Road near the Cienega Creek Bridge; just north of the preserve boundary along the Union Pacific Railroad right-of-way; and a single individual was found on the Well Access Road. This last population was hand-removed when it was discovered.

Species Ecological Profile
Buffelgrass is an aggressive invader. It can modify communities that it invades by allowing fire to carry through habitats that previously did not support fire. In Hawaii it has been observed to replace native grasses by its superior competitive abilities. It grows well in many different soil conditions. Buffelgrass is extremely drought tolerant, can withstand heavy grazing, and is extremely fire resistant (Morisawa, 2000). Burning, flooding and grazing are not effective control methods for this species (Tu, 2002).

Control Methods
Hand digging of buffelgrass has proven effective in eradicating the species. However, in areas (Tucson Mountain Park, Saguaro National Park and Organ Pipe National Monument) where it has been effective, large cadres of volunteers have been available to remove the plants (Sue Rutman, Organ Pipe National Monument, personal communication). Burning, flooding and grazing are not effective control methods for this species. Herbicides can be used to control buffelgrass, especially when combined with a manual method to first reduce the

standing buffelgrass biomass. A combination of glyphosate and ammonium sulfate has been shown to be the most effective herbicide treatment, but it needs to be repeated several times to kill the underground stems (Tu, 2002).

Management Priorities
Management of buffelgrass should be given a high priority. Populations of the plant in CCNP are currently small. The extremely invasive nature of the plant will allow buffelgrass to spread throughout the uplands of CCNP if these small populations are allow to expand. The currently small populations could be eliminated by hand pulling. Monitoring for new populations should also be conducted after the monsoon season along major roads in the preserve.

Watercress
***Rorippa nasturtium-aquaticum* (L.) Hayek**

Origin
Europe

Description
Water cress is a mat-forming aquatic plant. It has small, dark green succulent leaves and red colored stems and roots. Flowers are small and white.

Status of Cienega Creek Populations
Water cress is one the most common aquatic plants found in CCNP. It is found in most reaches exhibiting perennial flow.

Species Ecological Profile
Watercress is a perennial aquatic plant that can tolerate deep shade. It has naturalized throughout the United States. It has naturalized so completely into the American west that in a U.S. Forest Service riparian vegetation classification scheme there is a riparian community type that is dominated by watercress (Winward, 2000). Watercress has been found to suppress native species at a spring in New Zealand (Global Invasive Species Programme, 2000).

Control Methods
In the New Zealand spring mentioned above a program of hand weeding effectively controlled the watercress population; however, after removal the areas were then invaded by two non-native grasses and a non-native rush (Global Invasive Species Programme, 2000).

Management Priorities
Watercress is low on the list of species to control. Watercress has naturalized into many perennial streams throughout Arizona and the entire United States. It is believed that it has already successfully invaded all potential habitat in CCNP

and that the dynamic hydrologic nature of the riparian area in CCNP does not allow the species to completely dominate areas.

Tumbleweed, Russian thistle
***Salsola kali* L**

Origin
Russia

Description
Russian thistle is a multi-branched annual forb that can reach heights of up to four feet. The plant exhibits an extremely rounded growth form that facilitates the dispersal of seeds by allowing wind to roll the dried plant for long distances.

Status of Cienega Creek Populations
Russian thistle is found in most disturbed habitats in CCNP. Major infestations are found in areas that were previously used as agricultural areas such as the old fields and horse pasture south of the caretaker's house near the Jungle Well[3].

Species Ecological Profile
Russian thistle colonizes bare desert areas and can invade disturbed plant communities. It can grow in any un-compacted soil type. Individual plants are not good competitors and can be replaced through succession if the area is not re-disturbed or left as bare ground (Colorado Natural Areas Program, 2000).

Control Methods
Pulling of young plants and mowing can be used to control Russian thistle. However, mechanical control must be repeated for several years to exhaust the Russian thistle seed bank. Also seeds of Russian thistle can be reintroduced from offsite via the plant's unique method of seed distribution. There are two species of moths (*Coleophora klimeschiella* and *C. partenica*) that have been used as biocontrol agents for Russian thistle. Glyphosate can be used to control Russian thistle. Application rates at 1.5 pounds of active ingredient per acre have been used successfully (Colorado Natural Areas Program, 2000). Although 2,4-D herbicides have been used to control Russian thistle, they can cause Russian thistle leaves to become tough and leathery, producing a plant that is more difficult to control (Morisawa, 1999). Fire is not suggested as a control method as Russian thistle can easily re-colonize open areas left after fire (U.S. Department of Agriculture, 2002a).

Management Priorities
Annual growth form and constant seed input from areas outside the preserve makes Russian thistle difficult to completely control. The fact that Russian thistle

[3] Location found in Pima Association of Governments (1998).

is found in disturbed habitats makes the most effective control method to restore disturbed areas in the Preserve to their native vegetative cover. This will both reduce current populations and inhibit re-infestation.

London rocket
***Sisymbrium irio* L.**

Origin
Europe

Description
London rocket is a winter annual forb of the mustard family. It can grow to three feet in height given abundant rainfall. Flowers are yellow and quite small. Leaves are up to eight inches long and are fleshy and pointed.

Status of Cienega Creek Populations
London rocket is found throughout CCNP. Individual populations are not dense. It should be noted that surveys for this report were conducted during a dry period. London rocket, like other winter annual species, would have its largest populations during a wet winter and the following spring.

Species Ecological Profile
London rocket is a small annual plant. In Arizona it is mostly found in irrigated fields, roadsides, and disturbed areas. It is not known if it displaces native species.

Control Methods
No control methods for London rocket were found.

Management Priorities
Priority for management of London rocket is low. The annual growth form and well dispersed populations would make control extremely difficult. Additionally, London rocket does not form large dense stands that exclude native vegetation to any large extent.

Johnsongrass
***Sorghum halepense* (L.) Pers.**

Origin
North Africa

Description
Johnson grass is a stout perennial bunch grass that can reach heights of up 10 feet. The flowering structure (an open panicle) can be up to 20 inches in length.

Status of Cienega Creek Populations
Johnson grass is very common in the flood plain of Cienega Creek and Davidson Canyon. It occurs adjacent to perennial, intermittent, and ephemeral reaches of stream. Population size can range from a few scattered individuals in areas dominated by Bermuda grass and deer grass (*Muhlenbergia rigens*), to large monotypic stands that cover areas of approximately 2 acres in size. In the 2002 surveys, populations of Johnson grass appear to have increased in size and density from surveys conducted in 2001 (PAG Staff, Pima County Natural Resources, Parks and Recreation Staff personal observations).

Species Ecological Profile
Johnson grass is an invasive weed that thrives in disturbed soils. Johnson grass has an extensive system of rhizomes that can sprout when fragmented. Additionally it produces large crops of seeds. Johnson grass can tolerate a wide range of environment conditions. (Newman, 1993).

Control Methods
Small infestations of Johnson grass can be controlled by hand-pulling the plants when the soil is moist (Virginia Natural Heritage Program, 1999). Acceptable control of Johnson grass has been obtained by mowing but this usually requires multiple mowings per year over several growing seasons (Colorado Natural Areas Program, 2000). Tilling also has been proven to remove populations of Johnson grass when conducted six to eight times at two week intervals (Warwick and Black, 1983; McWhorter, 1981). Chemical control methods alone will not successfully eradicate Johnson grass. Glyphosate is recommended as a herbicide for use in natural areas. Best results are obtained with fall applications of glyphosate, followed by a tilling timed at least one week after the herbicide application (Newman, 1993).

Management Priorities
The immense effort necessary to enact control and the large population size places the control of Johnson grass into the low priority category. Additionally, populations of the grass are often in remote portions of the preserve. However, Johnson grass was listed as one of the Sonoran Desert's ten least wanted weeds (Arizona-Sonora Desert Museum, 1999) and one of the world's ten worst weeds (Holm et al., 1977).

Saltcedar, fivestamen tamarisk
***Tamarix chinensis* Lour**

Origin
Eurasia

Description
Saltcedar is a deciduous scale-leafed large shrub or small tree that can grow to 15' in height. The scale-like leaves are born on slender branches and are bluish-green in color. Flowers are born on the end of branches and are white to pink in color (Kearney and Peebles, 1960).

Status of Cienega Creek Populations
Saltcedar populations are very small in CCNP as compared to other Arizona streams with perennial water flow. However, tamarisk individuals are commonly found throughout the preserve, mostly within the floodplain of Cienega Creek. Very few large individuals are found in the preserve. Most individuals in the preserve are scattered, not found in large monospecific stands. However, larger stands of tamarisk are beginning to be found in areas where perennial reaches of the creek end. The Davidson Canyon portion of the preserve is remarkably free from tamarisk.

Species Ecological Profile
Saltcedar is an aggressive woody invasive plant that establishes in riparian areas. It can survive a large range of environmental conditions once it becomes established. It can spread rapidly due to multiple reproductive methods. It produces large quantities of small seeds and can vegetatively reproduce through buried or submerged stems. Once established saltcedar is a facultative phreatophyte, meaning that it can draw water from a shallow aquifer but once established it can survive without access to groundwater. Saltcedar can survive saline conditions by concentrating salts in its leaves. Therefore, in areas where saltcedar leaf litter accumulates, the soil can become highly saline, thus inhibiting many native species (DiTomaso, 1996).

Saltcedar can replace or displace cottonwoods and willows, especially when the timing and amount of peak water discharges, salinity, temperatures, and substrate texture have been altered by human activities (Carpenter, 1998). However, it has been noted that saltcedar does not replace native vegetation along western rivers that still experience large floods that are primarily timed in the spring rather than the summer and are relatively free of human hydrological manipulation (ground water declines and damming for examples) (Stromberg, 1998; Everitt, 1980).

Control Methods
Cut stump applications of Garlon 4 mixtures have be found to kill up to 85% of individuals. This kill ratio is higher than the kill ratio from a basal bark exterior

application of Garlon 4, which only killed 60% of the individuals (Faull, 1998). This method of control is most effective in the fall when the trees are actively translocating photosythate to their roots. Also the cut stump method is most effective when the stems are cut within two inches of the ground and the herbicide is applied within one minute of cutting. It is important to monitor treatment areas and re-treat tamarisk that was not killed by the initial treatment.

Saltcedar appears to be a good candidate for biological control. All species of the family Tamaricaceae are native to the Old World. A Eurasian leafhopper insect (*Opsius stacogalus*) has been identified in the United States. The source of the leafhopper is unknown, but is believed to have been accidentally imported along with *Tamarix. O. stactogalus* does act as a biocontrol agent, however by itself it does not provide effective control of saltcedar. Four other *Tamarix*-specific arthropods have been recorded in the United States, but none of these species cause significant damage to *Tamarix* individuals (DeLoach, 1999). Saltcedar leaf beetle (*Diorhabda elongata*) has been released as a biological control agent by USDA Agricultural Research Service (ARS) in California, Colorado, Nevada, Texas, Utah, and Wyoming (Stelljes, 2001).

The manna mealybug (*Trabutina mannipara*) has also been tested and is believed to be host specific to the *Tamarix* genus (DeLoach, 1999). However, when the manna mealybug is used without additional biocontrol agents, reductions in saltcedar populations are only expected to be 10 to 30% (Tracy and DeLoach, 1998). An additional five species of insects have also found to have some degree of host specificity to salt cedar and show promise as potential biological control species. The insects are three Gall midges (*Psectrosema nigrum, P. album,* and *P. acuticorne*), a weevil (*Hypophyes pallidulus, Corimalia tamarisci, Coniatus tamarisci*), a pterophorid moth (*Agdistis tamaricis*), and a leaf beetle (*Stylosomus* prob*. tamaricis*) (Sobhian et al., 1998).

Management Priorities

Saltcedar has the potential to displace native vegetation. However, that there are no upstream water diversions and the flood cycle at Cienega Creek has not been modified significantly reduce the risk of replacement of native vegetation with saltcedar woodlands. The populations of saltcedar are however currently quite small and have the potential to increase. The small size of the populations would make control now easier than if the population increased in the future. Also the presence of saltcedar in CCNP reduces the “naturalness” of the preserve. Control of saltcedar would then be ranked as a moderately important species to attempt to control in the preserve.

Periwinkle
***Vinca* sp. L.**

Origin
Southern Switzerland to the Mediterranean from Portugal to North Africa (Lawrence, 1959)

Description
Periwinkle is a perennial evergreen creeping herb. Stems often root at nodes. Leaves are dark green in color, shiny, oval-shaped, and up to 3 inches in length. Flowers are blue lavender in color, tubular with 5 lobes, two inches long, and appear March through July (Eppel & Eppel, 1995).

Status of Cienega Creek Populations
One population has established in the preserve south of the creek in an ephemeral tributary of Cienega Creek under a heavy mesquite canopy.

Species Ecological Profile
Periwinkle can form dense mats that exclude other herbaceous species and seedlings of woody plants. It is an extremely shade tolerant species (Personal Observation). Dry and hot conditions can cause periwinkle to die back (Muenscher, 1955). In California, periwinkle does not reproduce by seed (Salisbury, 1961). Reproduction in Arizona is assumed to be similar and take place mainly by vegetative reproduction, via stolons that root at notes. In this fashion, patterns of invasion would be both up and down drainages, where a tree canopy exists.

Control Methods
Mechanical control is the preferred method of control for periwinkle. Muenscher (1955) suggests that the solons first be raised by a rake and then closely mowed or hand dug for effective removal.

Chemical control of periwinkle is difficult due to the thick waxy cuticle. Even the makers of RoundUp™ advise against use on periwinkle. However, experiments in Ramsey Canyon in the Huachucha Mountains have shown that precutting periwinkle with a scythe five to ten minutes before herbicide application allows sufficient absorption of the herbicide to kill the plant. Treatment was also shown to be most successful when soil temperatures and moisture is optimal for plant growth, such as occur during the monsoon season in the CCNP area (Bean and Russo, 1988).

Management Priorities
The remote location of the population of periwinkle in CCNP complicates eradication of the species, however, the extremely small size and local nature of the population would facilitate eradication efforts. The threat posed by the species is small, because many of the areas in which periwinkle could potentially

occur are already dominated by Bermuda grass. Given the fact the species could actually be eradicated from the preserve, the priority for control efforts of periwinkle is moderate.

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Del Lago Golf Club

Colossal Cave Rd.

Coronado National Forest

Colossal Cave Mountain Park

Del Lago Well

Marsh Station Rd.

Cienega Well

Jungle Well

Interstate 10

Empirita #2 Well

O'Leary Windmill Well

Empirita Ranch Headquarters Area

Plate 1. Parcel ownership near Cienega Creek Natural Preserve

Legend

Cienega Creek Natural Preserve Boundary

Land Ownership (based on PCLIS Version 19)

Government
- Pima County
- State of Arizona
- United States of America

Transportation
- Public Roadway
- Railroad

Private
- Industrial
- Utility Company
- Industrial - Currently Vacant
- Mining or Mineral Rights
- Commercial, Non-Profit, or Community Organization
- Commercial - Currently Vacant
- Golf Course
- Ranching Concern
- Residential Ownership
- Residential - Currently Vacant

PIMA ASSOCIATION OF GOVERNMENTS

0 1 2 3 Miles

N

Cienega Creek Natural Preserve Non-Native Species Study - April 2003

Plate 2. Observations of non-native plant populations

Legend

- Observed Non-Native Plant Populations Locations
- Cienega Creek Natural Preserve Boundary
- Cienega Creek
- Other Watercourses
- Roads
- Railroads

PIMA ASSOCIATION OF GOVERNMENTS

CAMINO LOMA ALTA

COLOSSAL CAVE ROAD

AGUA VERDE CREEK

MARSH STATION ROAD

DAVIDSON CANYON

INTERSTATE 10

HIGHWAY 89

MESCAL ARROYO

CYDA
PECI
PECI, ERLE
PECI
ERLE
ERLE
CYDA, TACH2
SOHA, TACH2, CYDA
ERLE
ECCO2
TACH2, SOHA
CYDA, SOHA, TACH2
CYDA, SOHA, TACH2
TACH2
ERLE
ERLE, SOHA
ERLE
CYDA, TACH2, SOHA
ARDO4
ERLE, SOHA, TACH2
PECI
CYDA, TACH2, SOHA
ERLE, MERE9, CYDA,TACH2
PECI
RONA2
SAKA, TACH2, SOHA
CYDA, TACH2
ERLE
SOHA, TACH2, CYDA
ERLE
SOHA
ERLE
SOHA
ERLO
ERLE
SIIR, SOHA
TACH2
ERLE
ERLE, TACH2, CYDA
ERSU, ERLE, SAKA
PECI
ERSU, ERLO, SAKA, PAAN4
PAAN4
PAAN4
CYDA, TACH2, SOHA
ERLO
TACH2, CYDA
TACH2, CYDA, SOHA, ERLE
SOHA, TACH2
SOHA
BRRU2
TACH2
VINCA
SOHA
CYDA, TACH2
CYDA, TACH2
CYDA, SAKA
CYDA, SAKA
ERLE
SAKA
CYDA, SAKA
SAKA, CYDA, SIIR
CYDA
CYDA, SIIR
CYDA, ERLE
ERCI
CYDA
ERLE
ARDO4
CYDA, SAKA

PLANTS Symbol	*Scientific Name*	Common Name
ARDO4	*Arundo donax*	Giant reed
BRRU2	*Bromus rubens*	Red brome
CYDA	*Cynodon dactylon*	Bermudagrass
ECCO2	*Echinochloa colona*	Jungle rice
ERCI	*Eragrostis cilianensis*	Stinkgrass
ERLE	*Eragrostis lehmanniana*	Lehmann lovegrass
ERSU	*Eragrostis superba*	Wilman lovegrass
MERE9	*Melinis repens*	Rose Natal grass
PAAN4	*Panicum antidotale*	Blue panicum
PECI	*Pennisetum ciliare*	Buffelgrass
RONA2	*Rorippa nasturtium-aquaticum*	Watercress
SAKA	*Salsola kali*	Russian thistle, tumbleweed
SIIR	*Sisymbrium irio*	London rocket
SOHA	*Sorghum halepense*	Johnsongrass
TACH2	*Tamarix chinensis*	Fivestamen tamarisk
VINCA	*Vinca sp.*	Periwinkle

0 1 2 3 Miles

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Cienega Creek Natural Preserve Non-Native Plant Species Study - April 2003