# Status Report

# *Cirsium vinaceum*

(Sacramento Mountains Thistle)

## 2013

(Section 6, Segment 27)

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## INTRODUCTION

The Sacramento Mountains thistle (*Cirsium vinaceum* Wooton & Standley) is a short lived native thistle endemic to the Sacramento Mountains in Otero County, New Mexico. It is a federally threatened and NM State endangered plant restricted to travertine seeps and springs and associated creeks on limestone substrates within the mixed conifer zone, between 7,500 to 9,200 ft in elevation. The entire range of the species extends from approximately 6 miles northeast to 17 miles south of Cloudcroft (Figure 1; USFWS 2010). Suitable habitat for *Cirsium vinaceum* is relatively rare and spotty in distribution, ranging in size from several square feet up to 5 acres. The majority of occupied sites are less than 1 acre in size. The total area of occupied habitat is estimated at 70 acres, with greater than 95% of the known habitat occurring on Lincoln National Forest lands (USFWS 2010). Ten meta-populations have been identified containing over 70 documented sites; seven of these meta-populations contained live plants in 2012 (Figure 1; Table 1). Occupied habitats are often densely populated and can range from fewer than 10 individuals to up to several thousand flowering plants.

*Cirsium vinaceum* is an obligate wetland species that requires surface or immediately sub-surface water flows. It develops a basal rosette in the first year. Individual plants may produce more than one rosette along basal rhizomes. The plants go dormant in the fall and winter, greening up in spring and producing flowering stalks starting in late June. Flower stalks may reach six feet in height and produce numerous purple flower heads on a widely-branched inflorescence. Plants flower and set seed through the beginning of September. Adult plants die after flowering. Pollination is accomplished by insects, including the hawk moth, 28 species of bees, and five species of hummingbirds (Griswold 1990, Tepedino 2002). Seed production usually occurs from cross-pollination, although this species is partially self-compatible (Tepedino 2002). Many flower heads are found to be infested with insects and larvae at the end of summer (Sivinski 2008). *Cirsium vinaceum* appears to experience heavy seedling mortality, and also has low tolerance to freezing (Thomson 1991).

*Cirsium vinaceum* was federally listed threatened in 1987 due of its limited range, restricted habitat requirements and several threat factors that may impact its survival (71 FR 22933). Major threats include habitat destruction through the impacts of livestock, water development, competition with invasive plant species, road construction, logging, and recreational activities. Insect predation and disease were not considered threats in the original listing, nor the recovery plan (USFWS 1993). Since then, *Cirsium vinaceum* plants have been documented to host a number of native and introduced insect species that prey on the plant and its flower heads (Gardner and Thompson 2008; Barlow-Irick 2007; Sivinski 2007 - 2010, Burks 1994). Burks (1994) found the overall seed predation by insects consumed or damaged roughly 17% of the seeds produced by this thistle before dispersal. Sivinski found four native insect predators and one exotic species on *Cirsium vinaceum* (2007). A Tephritid gall fly, *Paracantha gentilis*, was the most ubiquitous native insect predator on the flower heads. Larvae of the native Pterophorid plume moth *Platyptilia carduidactyla* and adult flower bumble beetles, *Euphoria inda*, also preyed upon flower heads in most *Cirsium vinaceum* populations, but to a lesser extent than *P. gentilis*. Sivinski also documented, for the first time, a native stem boring weevil, *Lixus pervestitus*, which is seriously impacting the Silver Springs population by causing premature death of the flowering stems. Although a native species, this may be a new predator on *Cirsium vinaceum* that is expanding its range to higher elevations due to climate change. In addition, the introduced seed-head weevil *Rhinocyllus conicus* was found on musk thistles in the northern part of the Sacramento Mountain range near Ruidoso in the summer of 2001 (USFS 2003). *Rhinocyllus conicus* is native to Eurasia and was intentionally introduced to North America in 1968 as a biological control agent for musk thistle, *Carduus nutans*, a noxious weed. This weevil has subsequently spread to at least 26 states where it is attacking both musk thistle and native thistle species (Dodge 2005). In 2006 these exotic weevils were documented in flower heads of the Silver Springs thistle population in the Sacramento Mountains (Sivinski 2007). A range wide survey for *R. conicus* in 2007 found continued occupation at the Silver Springs population and a few egg scars were found in one musk thistle population within the Peñasco watershed near known sites of *Cirsium vinaceum* (Gardner and Thompson 2008). *Rhinocyllus conicus* and *Lixus pervestitus* were documented annually at the Silver Springs population of *Cirsium vinaceum* between 2006 and 2010 (Sivinski 2006 - 2010). Impacts from the two weevils resulted in almost complete failure of seed production.

The primary focus of this study was to assess the use of *Cirsium vinaceum* plants by these two insect predators at known sites between Silver Springs and the southernmost population at Scott Able Canyon and to determine whether *Rhinocyllus conicus* and *Lixus pervestitus* have spread to other populations in the Sacramento Mountains. Identification of the extent of the spread of these predatory insects will contribute to our understanding of what degree of threat these predators might pose on the species and its recovery. Once identified, plans can be developed to monitor and combat the infestations.

**Objectives**

1. Determine if *Rhinocyllus conicus* has spread to other populations of *Cirsium vinaceum* and musk thistle (when present) at each location.
2. Determine if *Lixus pervestitus* has spread to other populations of *Cirsium vinaceum* and musk thistle (when present) at each location.
3. Assess current ecological condition of sites visited.
4. Make management recommendations to address documented insect infestations and other disturbances observed in the habitat of *Cirsium vinaceum.*

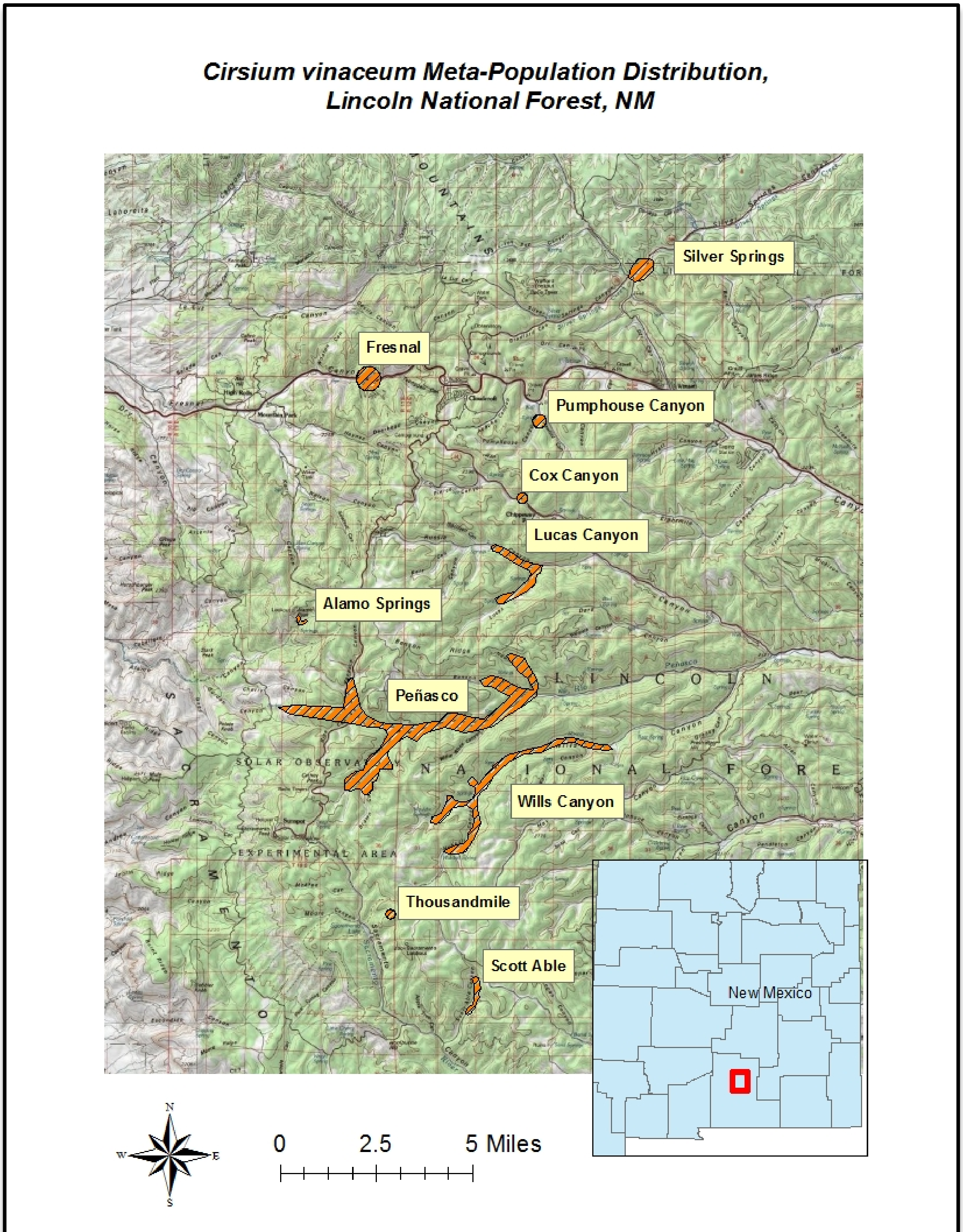


Figure 1. Distribution of *Cirsium vinaceum*, Lincoln National Forest, Otero County, NM. 2012.

## METHODS

Locational information for 74 documented sites was provided by the New Mexico Heritage Program. Additional site specific information came from the Lincoln National Forest and the U.S. Fish and Wildlife Service. Using the 2004 NatureServe generic habitat based plant element occurrence delimitation guidance, known sites of *Cirsium vinaceum* were delineated into 10 meta-populations (Figure 1). A meta-population is defined as a geographically distinct population of *Cirsium vinaceum* containing one to many documented sites of occupied habitat. It is a grouping of plants between which genetic exchange is likely, based on suitable habitat and estimated dispersal distances.
Sixty-one sites representative of the entire range of *Cirsium vinaceum* on the Lincoln National Forest were surveyed and delineated using GPS in mid to late July 2012. Plants were visually examined for the presence of *Rhinocyllus* and *Lixus*. The presence of *Rhinocyllus* was determined by observing egg cases deposited on the outer phyllaries of flower heads (Figure 2). *Lixus* infestation was determined by the presence of stem lesions along the flowering stems (Figure 2). Sampling for insect infestation took place on all flowering stems in populations with less than 50 flowering plants, approximately 50 flowering stems in sites with > 50 flowering plants and less than 500 plants, and a minimum of 100 flower heads at large sites containing five hundred or more plants. In mid-September 2012 a total of 520 flowering plants and 520 seed heads were sampled from four meta-populations (Lucas Canyon, Penasco Canyon, Scott Able Canyon, Silver Springs), including 11 sites. 100 mature seed heads were sampled from each of four large sites (Bluff Spring 1, Penasco 43, Water Canyon 46 & 80, Silver Springs), and 60 were sampled in two medium sized sites (Lucas Canyon 31, 32, 68, Scott Able 1,2, 3) to determine if *Rhinocyllus* and *Lixus* developed within the seed heads and stems. In addition, the presence of gall fly larvae (*Paracantha gentilis)*, was noted and the percent of mature seeds per seed head was estimated for each sampled seed head.

Density of flowering or bolting thistle plants was estimated using ocular estimations. Also noted were associated species, the presence and type of pollinators, surface water, livestock impacts to habitat and plants, presence of musk thistle (*Carduus nutans*), and other disturbances such as downed fences (exclosures), other invasive plants, and mold. If musk thistle were found within 500 ft of an occupied site, plants were sampled for the presence of *Rhinocyllus* and *Lixus*. Additionally, *Rhinocyllus* was previously documented in musk thistle populations at Marcia Cemetery in the Rio Peñasco drainage (Gardner & Thompson 2007). Therefore, this musk thistle population was sampled again in September 2012 to determine if any *Rhinocyllus* or *Lixus* larvae were present within the seed heads or in the stems.

**Adult**

**Larva**

**Stem lesions**
***Lixus pervestitus***

**Adult**

**Larva**

**Egg sites**
***Rhinocyllus conicus***

**Figure 2.** *Lixus pervestitus* and *Rhinocyllus conicus* on *Cirsium vinaceum* in the Sacramento Mountains, Otero County, NM. Photos by B. Sivinski.

## RESULTS

### Summary

- No plants were found in three of the ten meta-populations. Of the 61 previously documented sites visited in 2012, 43 still contained live plants (73%) (Table 1).
- The majority (77%) of occupied sites contain less than 100 flowering stems of *Cirsium vinaceum* (Table 2).
- The Silver Springs meta-population remains the only site with significant impacts from *Rhinocyllus* and *Lixus* infestation (Table 4). Of 234 flower heads examined in July 2012, 190 showed signs of *Rhinocyllus* infestation (81%). Of the 222 plants examined for *Lixus* infestation, 92% were had stem lesions associated with *Lixus* infestation.
- Follow-up surveys and sampling in mid-September at Silver Springs documented *Rhinocyllus* larvae in 90% of the sampled seed heads and *Lixus* in 100% of sampled plants.
- *Rhinocyllus* was also present at one site within the Peñasco meta-population. *Lixus* was present in 4 additional sites in the Penasco meta-population. No *Lixus* or *Rhinocyllus* were documented during September follow-up surveys and sampling at these sites.
- The majority of sampled flower heads (56%) did not contain any mature seeds by mid-September 2012 (Table 3).
- The majority of sites were livestock accessible (84%) and documented damage to plants and their habitat (72%) caused by livestock (Table 5).
- The majority of protective exclosures were no longer functional (82%) (Table 5).
- Just over half of the 61 sites visited had surface water present (56%). Surface water was present in 34 of the 43 sites where plants were found in 2012 (79%).

**Table 1.** 2012 Meta-populations of *Cirsium vinaceum* near Cloudcroft, NM. Number of sites documented by NHNM & visited, and the number of sites with extant plants.

| Metapopulation | Number of sites surveyed/# of previously documented sites | Number of extant sites |
|---|---|---|
| **Silver Springs** | 1/2 | 1 |
| **Peñasco** | 28/42 | 24 |
| **Alamo Springs** | 4/2 | 3 |
| **Fresnal Canyon** | 1/1 | 1 |
| **Scott Able Canyon** | 4/2 | 3 |
| **Lucas Canyon** | 7/9 | 4 |
| **Wills Canyon** | 12/11 | 7 |
| **Thousandmile Canyon** | 2/2 | 0* |
| **Pumphouse Canyon** | 1/1 | 0[1] |
| **Cox Canyon** | 1/2 | 0[1] |
| **Total** | **61/74** | **43** |

*not found in 2012; possibly mapping error. [1] none found in 2012; likely extinct.

**General Distribution and Abundance**

Only 7 of the 10 delineated meta-populations contained plants. The Thousandmile Canyon population could not be located. The 2 mapped sites were not located in the appropriate habitat. The Thousandmile Canyon sites had almost 400 flowering plants in 2007 (Barlow-Irick 2007). It is assumed that these sites may still exist but were not mapped correctly. The Cox Canyon population was mapped in the appropriate habitat but no plants were found. Only one flowering plant was documented from this site in 2007 (Barlow–Irick 2007). This population is presumed extinct. The last documentation of *Cirsium vinaceum* in the vicinity of the Cloudcroft Ski Area was in 1978 (Pumphouse Canyon meta-population). No plants were found in this area and the population is presumed extinct.

Only 43 of the 61 sites contained live plants in 2012 (Table 1). The majority of sites contained less than 100 flowering stems (Table 2). Only 3 sites contained more than 500 flowering stems (Silver Springs, Water Canyon, Bluff Springs). The Peñasco meta-population contains the largest number of occupied sites (24). The Silver Springs meta-population contains only one site, which is the largest occupied site. The majority of sampled flower heads (56%) did not contain any mature seeds by mid-September 2012. Of the 520 seed heads sampled, 34 % contained 20% or fewer mature seeds (Table 3).

Forty-nine sites sampled in 2012 had previous estimates for the number of flowering stems per site (NHNM 2012, Barlow-Irick 2007). Sixty-one percent of these 49 sites showed a significant decline in the estimated number of flowering stems, 14% went extinct since the last census, 8% showed an upward trend, and 6% of these sites appear stable in their numbers. Ten percent of the sampled sites had not been recolonized and remained without any plants since the last census. These are presumed extinct.

**Table 2.** Abundance of flowering stems within 43 occupied sites among 7 meta-populations of *Cirsium vinaceum* in the Lincoln National Forest, 2012.

| Meta-population/ # of occupied sites visited | 1 - 10 flowering stems | 11 - 50 flowering stems | 51- 100 flowering stems | 100 - 500 flowering stems | >500 flowering stems |
|---|---|---|---|---|---|
| **Silver Springs (1)** | | | | | 1 |
| **Peñasco (24)** | 3 | 6 | 6 | 7 | 2 |
| **Alamo Springs (3)** | 2 | 1 | | | |
| **Fresnal Canyon (1)** | | 1 | | | |
| **Scott Able Canyon (3)** | 1 | 2 | | | |
| **Lucas Canyon (4)** | 1 | 1 | 2 | | |
| **Willis Canyon (7)** | 3 | 3 | 1 | | |

**Table 3.** The number of seeds heads sampled and the percent of mature seeds found in seed heads of *Cirsium vinaceum*, Lincoln National Forest, 2012.

| | | | Number of seed heads with mature seeds | | | | |
|---|---|---|---|---|---|---|---|
| **Meta Population** | **Site Name** | **n** | **0%** | **1 to 20 %** | **21 to 40 %** | **41 to 60 %** | **>61%** |
| **Lucas Canyon** | Lucas Canyon 31, 32, 68 | 60 | 43 | 16 | 1 | 0 | 0 |
| **Peñasco Canyon** | Water Canyon 46, 80 | 100 | 58 | 30 | 9 | 3 | 0 |
| **Peñasco Canyon** | Bluff Spring 1 | 100 | 58 | 38 | 4 | 0 | 0 |
| **Peñasco Canyon** | Peñasco 43 | 100 | 57 | 30 | 11 | 2 | 0 |
| **Scott Able Canyon** | Scott Able, all | 60 | 35 | 25 | 0 | 0 | 0 |
| **Silver Springs** | Silver Springs | 100 | 38 | 35 | 17 | 7 | 3 |
| | **TOTAL** | **520** | **289** | **174** | **42** | **12** | **3** |
| | **Percent of all sampled plants** | | **56%** | **34%** | **8%** | **2%** | **0.6%** |

**Insect infestation**

*Rhinocyllus* and *Lixus* were abundant in the Silver Springs population during July and September surveys. By September 100 % of *Cirsium vinaceum* plants sampled were infested by the stem borer weevil, Lixus, and 90 % of all sampled plants contained *Rhinocyllus larvae* (Table 4). Follow-up surveys during September 2012 to confirm the presence of *Lixus* and *Rhinocyllus* in sites documented to contain the predators in July and to verify the absence of these insects in other sites did not confirm the presence of either insect outside the Silver Springs populations (Table 4). Four plants were thought to contain *Rhinocyllus* egg cases at one site in the Peñasco meta-population (Bluff 1). *Lixus* was thought to be present at 4 sites in the Peñasco meta-population (Bluff 1, Water Canyon 46, Peñasco 25 & 26), on one sampled plant at each site. Neither one of the weevils were found during the September surveys in these 4 sites when seed heads and stems were examined for larvae. The native gall fly, *Paracantha gentilis*, was found in the seed heads of 42 – 60 % of the 520 seed heads sampled during September 2012.

**Table 4.** Extant meta-populations of *Cirsium vinaceum* near Cloudcroft, Otero County, NM. Number of sites with *Rhinocyllus conicus* and *Lixus pervestitus* infestation, and the number of sites also containing musk thistle (*Carduus nutans)* populations.

| Meta-population (# of occupied sites visited) | # of Sites with *Lixus* July/September | # of Sites with *Rhinocyllus* July/September | # of Sites with musk thistle |
|---|---|---|---|
| Silver Springs (1) | 1/1 | 1/1 | 1 |
| Peñasco (24) | 4/0 | 1/0 | 16 |
| Alamo Springs (3) | 0/0 | 0/0 | 0 |
| Fresnal Canyon (1) | 0/0 | 0/0 | 0 |
| Scott Able Canyon (3) | 0/0 | 0/0 | 0 |
| Lucas Canyon (4) | 0/0 | 0/0 | 4 |
| Willis Canyon (7) | 0/0 | 0/0 | 5 |

**Invasive Species and Herbicide Application**

In 2012 invasive species associated with *Cirsium vinaceum* sites included musk thistle (*Carduus nutans*), teasel (*Dipsacus fullonum*), mullein (*Verbascum thapsus*), bull thistle (*Cirsium vulgare*), tamarisk (*Tamarix chinensis*), and Siberian elm (*Ulmus pumila*). The most frequently found invasive species was musk thistle, followed by mullein and teasel.

Musk thistles were found near or with *Cirsium vinaceum* at 26 of the 43 sites visited (61%) (Table 4). *Rhinocyllus* was found in only one musk thistle population, at Silver Springs, where it was estimated that approximately 50% of sampled musk thistles contained *Rhinocyllus* egg sites. No *Lixus* stem lesions were found on any musk thistles sampled.

In addition, during September 2012, 100 seed heads of musk thistle were sampled for the presence of *Rhinocyllus* larvae near Marcia Cemetery, where it was documented during surveys in 2008 (Gardner and Thompson 2008). Stems were also examined for *Lixus* infestations. None of the sampled plants had lesions associated with *Lixus* infestations. Senescent flower heads showed no signs of seed predation (including *Rhinocyllus*) and did not contain any maturing seeds. Some of the more immature flower heads contained a few immature seeds. The majority of flowering plants (80-90%) had their flowers topped off. It was unclear whether these flowers were browsed or whether they aborted.

Herbicide spraying of musk thistles was observed within the Lucas Canyon meta-population, in Lucas Canyon and Russia Canyon (Figure 5). Although none of the *Cirsium vinaceum* plants had apparent damage from the treatment, herbicides were applied to musk thistles in the immediate vicinity of *Cirsium vinaceum* plants (Figure 5).

Figure 5. Herbicide impacts on musk thistle in Lucas Canyon. Note *Cirsium vinaceum* plants immediately behind the musk thistle (arrow).

**Livestock Impacts**

In 2012, 51 of the 61 sites (84%) visited were accessible to livestock. Seventy-two percent of the 43 occupied sites (31 sites) where plants were found livestock damage to plants or the habitat was observed, including trampling of plants and soils, trailing, browsed and damaged plants (Figures 3 & 4; Table 5). Twenty-two of the 61 sites contained old exclosures build by the U.S. Forest Service primarily to protect plants and their fragile habitat (Table 5). Only 4 (18%) of these exclosures were functional (keeping livestock out) in 2012, an additional three exclosures were considered partial functional (i.e. gates were open or livestock could enter through a section that was down; Figure 3). Only one of the functioning exclosures was constructed to protect *Cirsium vinaceum* (Water Canyon 51). The other three functioning exclosures were built to fence in springs (Alamo Canyon) or were constructed and maintained by the NM Department of Fish & Game and the U.S. Forest Service to protect wildlife (Wills Canyon 7424). Two of the old exclosures no longer contained plants (Wills Canyon 7418, 65).

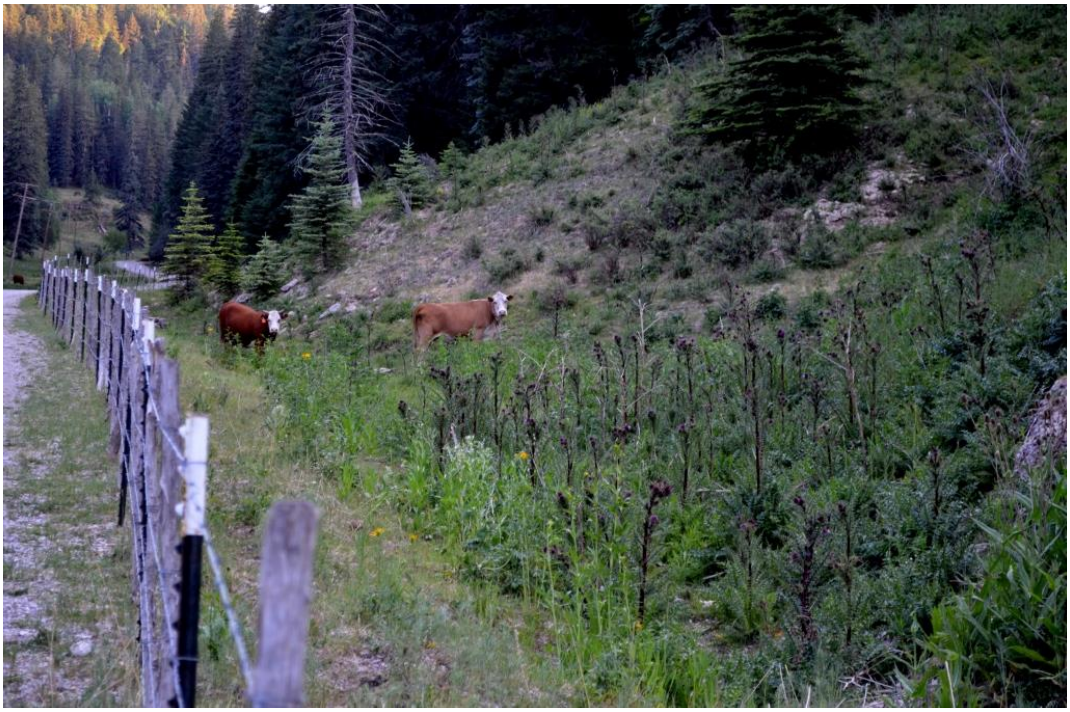

Figure 3. Livestock inside a partially functional exclosure (gate left open) for *Cirsium vinaceum* at Water Canyon (Peñasco meta-population).

Figure 4. Browsed *Cirsium vinaceum* rosettes at Bluff Springs (Peñasco meta-population).

**Table 5.** Extant meta-populations of *Cirsium vinaceum* near Cloudcroft, NM. Number of sites accessible to livestock, livestock damage observed, exclosure status, and water availability per site.

| Meta-population/# of sites visited | Livestock accessible | Livestock damage | Old exclosures | Functioning exclosures | Surface water present |
|---|---|---|---|---|---|
| **Silver Springs (1)** | 1 | 0 | 0 | 0 | 0 |
| **Peñasco (28)** | 27 | 21 | 12 | 1 | 21 |
| **Alamo Springs (4)** | 2 | 1 | 3 | 2 | 2 |
| **Fresnal Canyon (1)** | 0 | 0 | 0 | 0 | 1 |
| **Scott Able Canyon (4)** | 4 | 0 | 0 | 0 | 4 |
| **Lucas Canyon (6)** | 6 | 4 | 1 | 0 | 3 |
| **Willis Canyon (12)** | 11 | 5 | 6 | 1 | 3 |
| **TOTAL** | **51** | **31** | **22** | **4** | **34** |

**Roads and Off Highway Vehicle Trails**

Except for the Alamo Springs, Scott Able, and a few sites in the Peñasco meta-populations, the majority of sites are located in the immediate vicinity of paved or unpaved roads, including OHV trails. Several sites are bisected by dirt roads or OHV trails, which were observed to cause erosion and water diversions. In addition, the majority of invasive species documented in the vicinity of *Cirsium vinaceum* sites were associated with these road sides.

**Pollinators**

Hummingbirds, hawk moths, a variety of butterflies, and bees, including carpenter bees were observed in abundance within the majority of sites (Figure 5).

Figure 5. Western tiger swallowtail butterfly and carpenter bee on *Cirsium vinaceum* plants.

**Surface Water**

The presence of surface water is an important component of *Cirsium vinaceum* habitat. Just over half of the 61 sites visited contained surface water and was present in 34 of the 43 sites where plants were found in 2012 (Table 5). Overall there is a strong habitat preference for spring areas with surface water and shallow subsurface flows underneath thin travertine crusts. However, a few populations thrive along streamsides and in wet meadows, including the largest population of *Cirsium vinaceum* at Silver Springs (Figure 6). No surface water was present during June, July, or September visits. It is assumed that subsurface water contributes substantially to the presence of the thistles at Silver Springs, but the surface was dry during all three visits to the site.

Figure 6. Silver Springs population and habitat of *Cirsium vinaceum,* Lincoln National Forest 2012.

**Mold**

Mold was documented on many plants during the July surveys and on 83 to 100 % of all plants sampled in September. It does not appear to significantly impact individual plants although many plants were observed with premature blackened and senescent flower heads. It is unclear whether this withering was caused by the mold.

## Discussion and Management Recommendations

The results of this study are consistent with previous research and monitoring activities documenting declining populations, including the loss of sites and meta-populations as well as habitat throughout the entire range of the species (USFWS 2010; Barlow-Irick 2007). Although methods used for previous population estimates were not available and could therefore not be duplicated, the estimated number of plants per site was consistently and significantly lower than those estimated during the last available census counts. This decline is alarming and should be closely monitored.

The decline is likely a combination of drought, insect predation, and uncontrolled browsing of plants during the growing season, as well as habitat destruction and alteration caused by drought and livestock impacts. Seed predation by native and non-native insects and low seed set may also contribute significantly to this decline. Reasons for low fecundity are likely related to insect predation in all populations but may also be associated with low pollination success possibly caused by inbreeding depression, often associated with small isolated populations. Although no significant differences were found between seed set among small and large thistle patches in 1994 (Burks 1994), seed set appears to be significantly lower than previously reported in all sites and should be studied further. The availability of pollinators does not appear to be limiting; butterflies, hummingbirds and bees were observed in abundance at all sites in 2012. Low seed set was also observed among musk thistles at Marcia Cemetery. No insect predation was observed in any of the sampled seed heads. Reasons for limited or no seed set in musk thistles are unclear.

Musk thistle is an aggressive invader and has established throughout much of New Mexico, including road sides and many of the riparian areas in the vicinity of *Cirsium vinaceum* sites. Not only does it pose a threat through its competitive ability to displace native vegetation, it is also a carrier for the introduced biological control agent of musk thistle, *Rhinocyllus conicus*. Prior to its release, host range testing of *Rhinocyllus* revealed a potential for damage to several closely related genera, including *Cirsium* (Louda 2000). In fact, 2012 results show that *Rhinocyllus* appears to prefer *Cirsium vinaceum* over musk thistles at Silver Springs. In 2012, the percent of flowering heads with egg cases during July surveys and seed heads with larvae during September surveys was substantially larger than previously reported (Sivinski 2007, Gardner and Thompson 2007). Ninety percent of sampled flower heads contained *Rhinocyllus* larvae in September 2012. In addition, 100 % of all sampled plants were infested by the stem borer weevil *Lixus*. This is significantly impacting the reproductive capacity of the species and will lead to the ultimate decline of the largest population of this species. Therefore management of *Rhinocyllus* and *Lixus* and their host musk thistle is essential for the recovery and continued existence of the species. Furthermore, continuous monitoring of all populations is necessary to document impacts of insect predation on the thistles and implement management actions, if necessary, to halt the decline of the species.

Livestock impacts continue to account for the largest human caused impacts contributing to the decline of *Cirsium vinaceum*. Cumulative impacts of livestock combined with drought and insect damage is leading to a slow decline of plants in the majority of sites, thereby diminishing the potential for the recovery of the species and with it, jeopardizing its continued existence.

Livestock impacts have been documented in the past and include herbivory, trampling of plants and their habitat, impacts on seedling establishment and survival, and compaction of the soft-substrate travertine surfaces and associated lowering of the water table (Galeano-Popp 1994, USFS 2003). Trampling can cause damage to travertine formations or out-flow creek beds in ways that may alter water flow to sites. Alteration to the water flow can create conditions favoring the invasion of noxious weeds already present in the vicinity of many *Cirsium vinaceum* sites, thereby increasing competition and reducing the ability of successful establishment of seedlings.

Other observed or potential threats include spraying of herbicides in the Lucas Canyon/Russia Canyon area in the immediate vicinity of *Cirsium vinaceum.* Impacts caused by roads and OHV trails, including direct and indirect impacts such as erosion, the spread of invasive species, and water diversion along trails and roads, were observed throughout the range of the species. Travel and weed management activities and the protection of sensitive species need to be properly coordinated to avoid impacts on *Cirsium vinaceum*.

Despite the fact that over ten years of monitoring has documented the decline of the species at many sites (Barlow-Irick 2007), this documentation has not resulted in management actions to halt this decline and reduce impacts on the species from livestock related disturbances or insect predation. Although fencing populations has shown to increase thistle numbers and improve habitat for *Cirsium vinaceum* initially, the lack of fence maintenance has negated these improvements and the species continues on a downward spiral (Barlow-Irick 2007; USFS 2003; USFWS 2010). Restoring the exclosures to protect *Cirsium vinaceum* from livestock impacts and maintaining fencing is likely to greatly improve the status of this species. Insect infestations need to be addressed and managed at the Silver Springs population to avoid the spread of *Rhinocyllus* and *Lixus* to other populations of *Cirsium vinaceum*.

All populations of *Cirsium vinaceum* should be closely monitored and a monitoring plan should be developed to document population trends and threats as well as establish management triggers resulting in management actions that ensure the conservation and protection of the species into the future.

## ACKNOWLEDGEMENTS

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