Ciénega Restoration
Santa Rosa, NM
Case Studies and Lessons Learned
2006 - 2021

Daniela Roth & Carmen Austin
EMNRD – Forestry Division
Santa Fe, NM

INTRODUCTION

Ciénega is the Spanish word for "marsh", but it is also commonly used for a stable spring-fed wet meadow or marsh in an otherwise arid region (Sivinski 2018). Arid-land spring ciénegas are very rare and some are essential habitats for plants and animals that occur only in arid-land spring waters and ciénegas. For example, Blue Hole Ciénega and its associated spring run in Santa Rosa is the only known location where an as of yet undescribed round-nosed minnow species (*Dionda* sp.) occurs (Schönhuth et al. 2012). The Santa Rosa ciénegas are also home to an undescribed amphipod (*Gammarus* sp.) and little-known freshwater snails. Three rare and endangered plant species occur in the Santa Rosa ciénegas, including Pecos sunflower (*Helianthus paradoxus*), Wright's marsh thistle (*Cirsium wrightii*), and Great Plains lady's tresses (*Spiranthes magnicamporum*).

A significant number of ciénegas in the Southwest and New Mexico have been destroyed or severely altered (Sivinski 2018). Many of the privately owned arid-land spring ciénegas in New Mexico have been damaged by channeling and damming of spring flows to irrigate pastures and agricultural fields, especially in the Santa Rosa region. Those that retain their ecosystem functions require immediate attention through protection and/or restoration. Non-native invasive species cause serious problems in almost all of New Mexico's ciénegas. The most prevalent invasive plant species are introduced trees, including salt cedar (*Tamarix chinensis*) and Russian olive (*Elaeagnus angustifolia*). Ciénegas are by definition wide open meadows. These cannot persist in the understory of a tree canopy. There is also evidence that a forest of riparian trees can drop a ciénega water table several feet during summer months of active transpiration (Johnson et al. 2016).

Restoration efforts of ciénegas have been documented in the Santa Rosa area since 2005, when the EMNRD-Forestry Division purchased the 116-acre Blue Hole Ciénega for the purpose of protecting and enhancing the habitat of endangered plants, focusing on the federally and state listed Pecos sunflowers (Figure 1).

The Guadalupe Soil and Water Conservation District has been actively removing invasive trees along the Pecos River between Santa Rosa Lake and Fort Sumner since 2013, using mechanical treatment and pile burning, without herbicides. The SWCD later obtained several grants to implement restoration projects on privately owned ciénegas in the Santa Rosa area in 2016 & 2017, using the same methods (Table 1). In addition, Russian olive and salt cedar was removed from the NRCS Redhawk Conservation Easement on the south side of the Pecos River in 2013, in an effort to restore wetland habitats in the vicinity of Rock and Swan lakes. No herbicide was applied and there was significant resprouting.

In 2018 the Forestry Division obtained a U.S. Forest Service Landscape Scale Restoration Grant for the purpose of restoring Santa Rosa wetlands to enhance the habitat of Pecos sunflowers

and other rare and endangered plants, with a focus on maintaining and enhancing ciénega habitat on and in the vicinity of the restored Blue Hole Ciénega (Figure 1). This restoration project focused on all wetland areas previously treated for Russian olive and salt cedar removal and previously untreated ciénegas on state, City, and private lands. All treatment methods and locations of ciénegas in the vicinity of Blue Hole Ciénega since 2006 are documented in Table 1. Three of the restored ciénegas are featured in this report. Each ciénega has its own set of restoration challenges based on land ownership, management, location, and environmental conditions. Challenges and management recommendations to maintain the ecological functions of the Santa Rosa ciénegas and the habitat for endangered plants, especially Pecos sunflowers, are provided based on experiences learned since 2005 and site-specific circumstances. Restoration efforts and community engagement were documented in the 2020 documentary 'Saving Beauty' by Christina Selby and Arturo Anzures (https://www.savingbeautyfilm.com/).

Table 1. Restoration sites and treatment types in the Santa Rosa wetlands from 2006 – 2021

Location	2006	2007	2008	2009	2010	2011	2014	2016	2017	2018	2019	2020	2021
Blue Hole Cienega	1	1, 2	1, 6	1	6	6	1		1, 2	1	1	1	1
Milagro/City							1, 4		3,7	1	1	2, 5	1
El Rito/City									1	1, 4	1	1	
Perch Lake/City									1, 4	1	1, 2		
Below Perch Lake/City									3, 7	1	1, 2		
Fishponds/City								1		1, 4	1	1	
Ballpark/Armory								8		1, 4	1, 2		
Davis								7	3		1, 4	1	1
Houlihan/Senior Center								7	3		1, 4	1	1
Robinson								7	3		1, 4	1	1
Sanchez											1, 4	1	1
Quintana											1, 4	1	1
Micelli											1, 4		
Elevario									3,7		1, 4	1	
Water Treatment Plant									1	1, 4			
Twin Lakes /Country Club											1, 4		
CODES													
Cut and Herbicide	1												
Prescribed burn/broadcast	2												
Pile Burn	3												
Chipped	4												
Fencing	5												
Manual removal/hand pulling	6												
Mechanical Extraction	7												
Highstumped	8												

RESTORATION HIGHLIGHTS

1. BLUE HOLE CIÉNEGA

In 2005 the Energy, Minerals, and Natural Resources Department, Forestry Division, purchased Blue Hole Ciénega, to restore and protect this rare wetland for the benefit of three rare and endangered plant species: Pecos sunflower, Wight's marsh thistle, and Great Plains lady's tresses. All three species are state listed endangered, two of which are also either federally listed (Pecos sunflowers) or proposed for federal listing (Wright's marsh thistle). The Blue Hole spring run acequia runs from Blue Hole through Blue Hole Ciénega and empties into El Rito Creek. The acequia is the only known occupied habitat for an unnamed round-nosed minnow.

The USFWS Recovery Plan for Pecos sunflower grouped the seven known populations of Pecos sunflowers into 4 disjunct recovery regions, including the Santa Rosa region in eastern New Mexico (USFWS 2005). The recovery strategy is to protect and manage significant, sustainable portions (termed "core conservation areas") of each of the four region's sunflower habitats against the threat of future habitat loss and degradation. At least one core conservation area and one isolated stand of Pecos sunflower need to be protected in each region to meet the recovery criteria. All core conservation habitats must contain good or excellent populations. For a population to be ranked excellent several hundred thousand individuals need to be present. A good population for Pecos sunflower recovery purposes is a stand of at least 5,000 individuals during most (7 out of 10) years. Blue Hole Ciénega Nature Preserve was identified as a core conservation area for the Santa Rosa Recovery Region.

Blue Hole Ciénega has seen extensive and continuous management since it was purchased by the Forestry Division in 2005, from the initial removal of Russian olive and salt cedar, fencing and exclusion of livestock, to prescribed fires (Figures 4 – 7; Table 1). Population trends of Pecos sunflowers have been monitored on the Ciénega since 2013 (Roth 2021, Figure 2) and for

Wright's marsh thistle since 2017 (Roth 2021, Figure 3). Other monitoring activities on Blue Hole Ciénega include rainfall (since July 2016) and groundwater fluctuations (2014 - 2019, LeJeune 2018). Seeds of Pecos sunflowers were collected in 2020 and these are stored at the Albuquerque BioPark for ex-situ conservation purposes. Seeds of Wright's marsh thistle were collected in 2021 for the purpose of establishing a new population at the San Bernadino Cienega in Arizona.

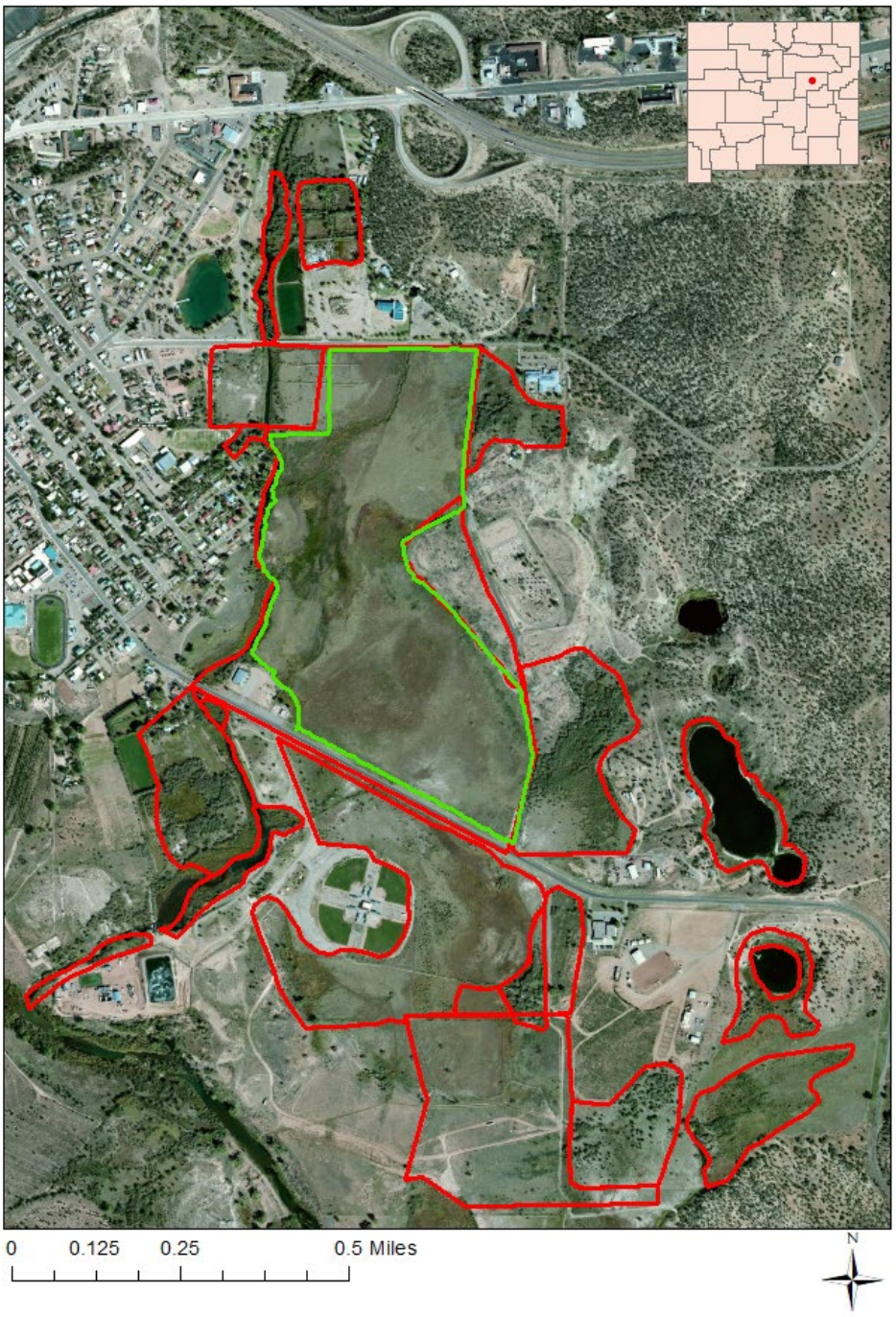

Figure 1. Wetland and riparian treatment areas in the vicinity of Blue Hole Ciénega (highlighted in green) in Santa Rosa.

Tracking population trends helps identify impacts of management actions, including the removal of invasive species, livestock impacts, and the impacts of prescribed fires. Population trends of Pecos sunflowers have been monitored along 11 30 m x 2 m transects on the Ciénega since 2013 (Roth 2021, Figure 2). Population numbers can fluctuate significantly between years, depending on rainfall, but a prescribed fire in 2017 significantly increased the number of plants found along the 11 transects (Figure 4). In the absence of fire this species would likely be in decline on the Ciénega. Cleary, this species needs some form of disturbance to thrive. However, the response of Wright's marsh thistle was less pronounced (Roth 2021, Figure 3). In fact, plant numbers decreased significantly post-fire and have not returned to pre-fire values since population trend monitoring was initiated in 2017. To what extent the fire is responsible for this observed decline verses natural population fluctuations is unknown.

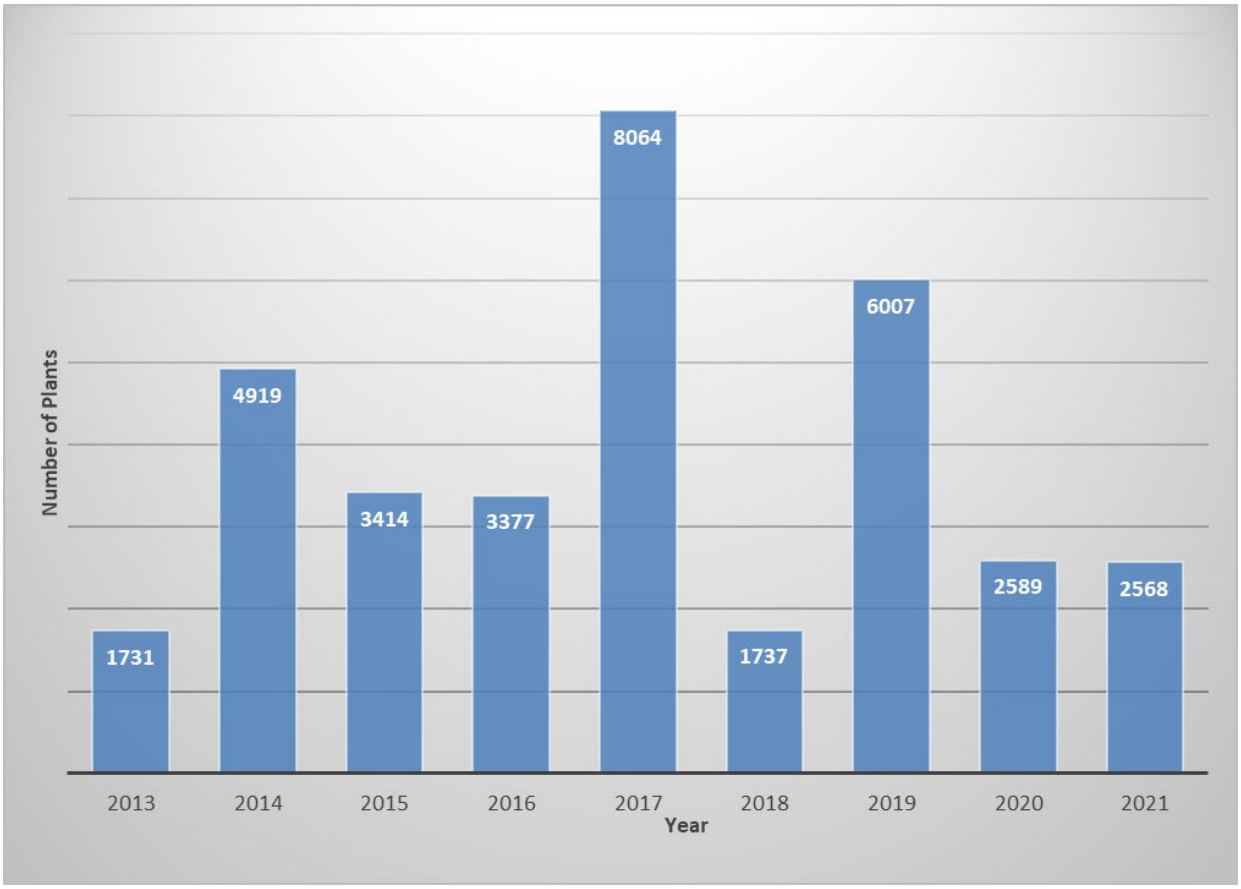

Figure 2. Population trends of Pecos sunflowers on Blue Hole Ciénega in Santa Rosa, 2013 – 2021.

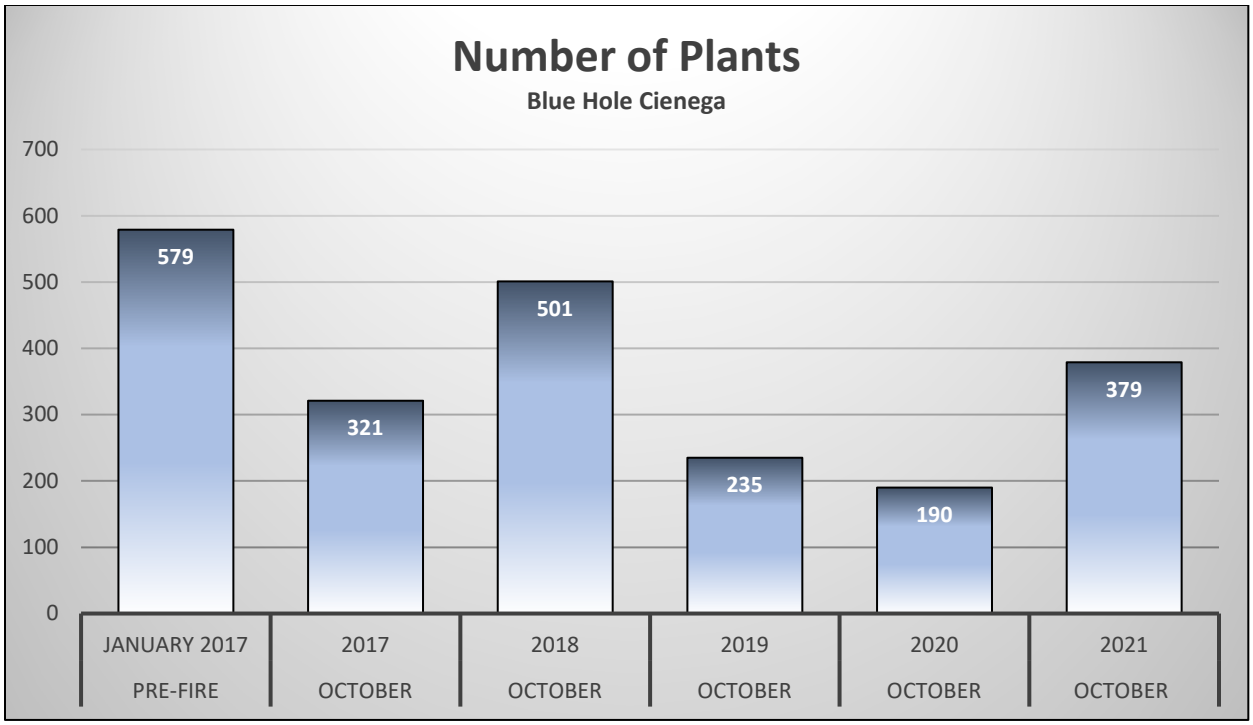

Figure 3. Population trends of Wright's marsh thistle at Blue Hole Ciénega in Santa Rosa 2017 – 2021.

Figure 4. Prescribed fire at Blue Hole Ciénega, February 2017.

Figure 5. The Forestry Division's Inmate Workcamp walking the Ciénega to look for and treat (cut and herbicide) Russian olive and salt cedar resprouts.

Figure 6. Pecos sunflowers at Blue Hole Ciénega, 12 years after initial treatment.

Figure 7. Wright's marsh thistle growing along the Blue Hole Acequia spring run.

CHALLENGES:

- Pecos sunflowers are adapted to a certain disturbance regime and the absence of disturbance has created a thick thatch of grasses and rushes in the habitat of sunflowers. While seedlings were found to germinate and establish even under the thickest thatch layers, plants appear to favor disturbance and less vegetated areas.
- Wright's marsh thistle do not respond positively to fire but are somewhat protected from direct impacts of fire by habitat preference (very wet).
- Careless herbicide applications can lead to dead zones for any type of plants, spanning many years (Figure 8).
- Acequia maintenance can negatively impact recharge of the wetland and should be avoided or otherwise mitigated.
- Historic efforts to drain the Ciénega via various drainage channels have become evident after a prescribed burn (Figure 9). These need to be filled or blocked to keep water on the Ciénega and enhance habitat for endangered plants.
- Groundwater levels appear to be in decline but need further study.

Figure 8. Birdseye view of Pecos sunflowers at Blue Hole Ciénega. A dead zone caused by overspray or leaching is visible in the center. Photo by Christina Selby

Figure 9. One of the historic wetland drainage channels uncovered by fire.

BLUE HOLE CIÉNEGA MANAGEMENT RECOMMENDATIONS:

- Burn the Ciénega every 5 years. Fire or other types of disturbance is essential for the continued existence of sunflowers on the Ciénega.
- Update and maintain the burn plan developed through the LSR grant in 2021.
- Block drainage channels following a fire when they are visible. Use caution with type of equipment to avoid bogging down in wet or shallow areas. This needs to take place after a fire and before emergence of sunflower seedlings.
- Consider seasonal grazing (November through February).
- Cut and stump herbicide treatments of Russian olive resprouts and other invasive woody species should be repeated at a minimum of every 5 years.
- Herbicides should be carefully applied with a brush. Herbicide types and concentrations need to be carefully studied to understand possible negative impacts on biotic resources.
- Consider reestablishing automated groundwater monitoring wells. A better understanding of groundwater fluctuations and trends is essential.
- Continue the annual population trend monitoring of Pecos sunflowers and Wright's marsh thistle. Consider drone surveys for better accuracy of annual cover fluctuations of sunflower populations (this could potentially replace annual monitoring along transects).
- Provide a better inventory survey for Great Plains lady's tresses. Consider monitoring sites to document population trends.
- Continue to engage with the local community by pursuing a boardwalk through the Ciénega for educational purposes and by becoming an active member of the Santa Rosa Wetland Alliance to follow recommendations of the Santa Rosa Wetland Action Plan (Quivira Coalition 2021).
- Engage with the Santa Rosa Acequia Association to ensure acequia operations, including clean-out, do not interrupt the function of the wetlands or the habitat of the as of yet undescribed round-nose minnow.

2. MILAGRO CIÉNEGA

Milagro Ciénega (previously known as City Ciénega) is a 15-acre ciénega owned by the City of Santa Rosa (Figure 10). It was identified as a secondary Core Conservation Area for the Santa Rosa Pecos Sunflower Recovery Region, as prescribed in the Pecos Sunflower Recovery Plan (Roth 2014, USFWS 2005). The City of Santa Rosa approved a 25-year Conservation Easement for Milagro Ciénega in 2018 and the Guadalupe Soils & Water Conservation District agreed to hold the Easement for the City. The Easement was granted to protect threatened and endangered species, enhance water quality and water supplies, protect endangered species habitat and maintain habitat connectivity and related values to ensure biodiversity, protect wetland areas, maintain and restore natural ecosystem functions and the rural community's cultural and economic vitality. Grazing is permitted during the winter months from November through February. Milagro Ciénega was initially only partially fenced but has been fully fenced since February 2020. It contains an unnamed mound spring which has been breached and water is directed off the property for the benefit of livestock. An unnamed amphipod and an endemic freshwater snail live in this spring and its associated spring run. Although containing a significant remnant population of Pecos sunflowers and a few Wright's marsh thistles and Great Plains lady's tresses, the Ciénega was largely overgrown with Russian olive and salt cedar prior to 2014 (Figures 11 & 12). The site was cut and stump treated by the Forestry Division's Inmate Work Camp in 2014 with funding from a USFWS grant. Since then, it has received multiple cut and herbicide treatments and a prescribed burn in February of 2020 (Table 1). In response to multiple restoration treatments including cutting and herbicide application and prescribed burning, Milagro Ciénega now contains one of the largest populations of Pecos sunflowers in the Santa Rosa area.

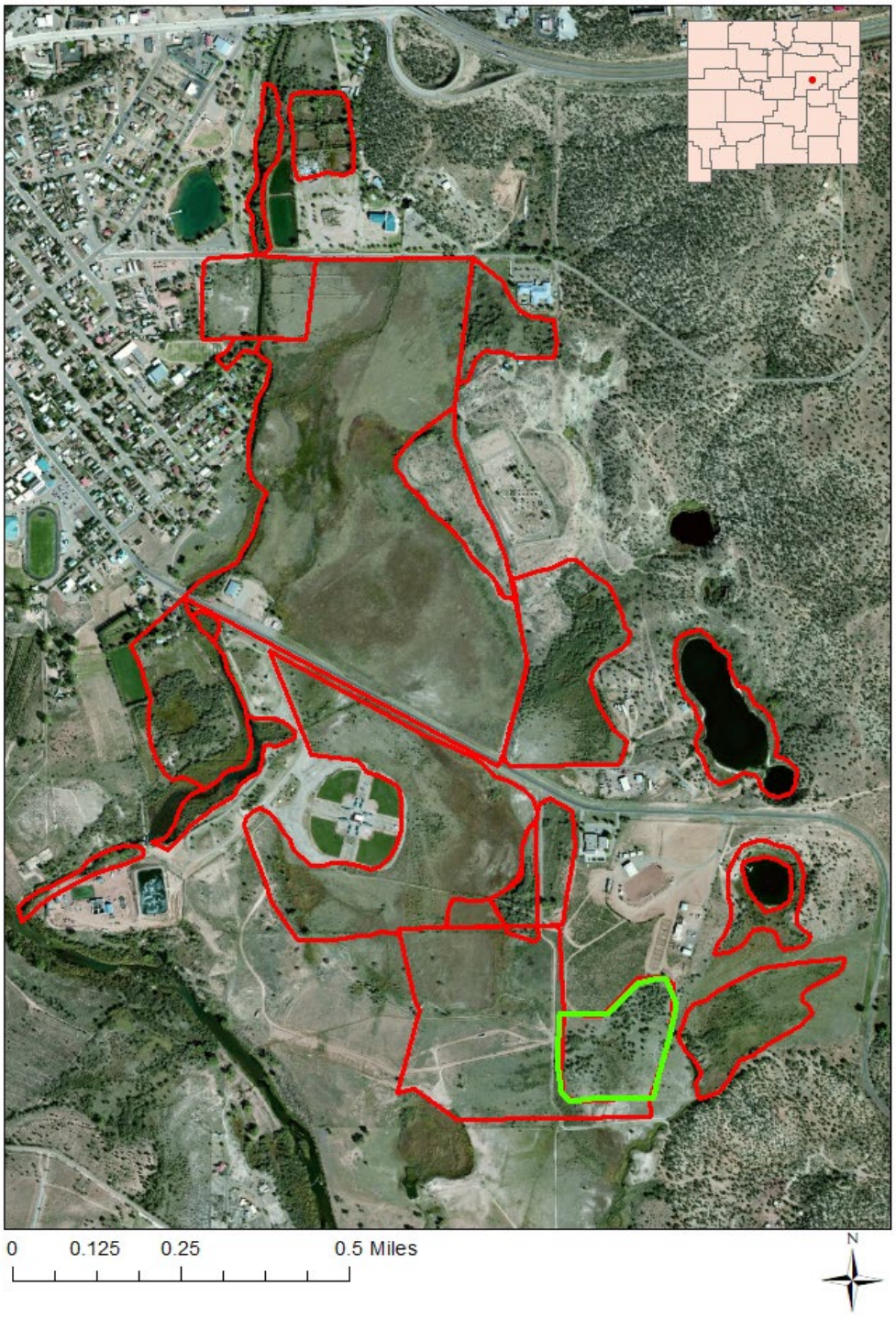

Figure 10. Location of Milagro Ciénega (highlighted in green) within the treatment areas for the Landscape Scale Restoration Project.

Figure 11. Milagro Ciénega, during initial cut & herbicide treatment in 2014.

Figure 12. Milagro Ciénega in 2014, after initial cut and herbicide treatment.

Population trends of Pecos sunflowers have been monitored along 8 30 m x 2 m transects at Milagro Ciénega since 2018 (Figure 13; Roth 2021). The sunflower population received a significant boost in numbers in response to a prescribed burn in 2020. Although populations are expected to fluctuate annually depending on rainfall amounts, fire clearly benefits the sunflowers during the initial growing season after the fire with effects possibly lasting for several years (Figures 14, 15, & 16). Livestock was allowed in Milagro Ciénega during the winter months of 2020/2021. No apparent impacts from grazing during the winter months were observed in the habitat, nor by the number of plants or distribution of plants. Impacts of seasonal grazing are difficult to ascertain without a control site.

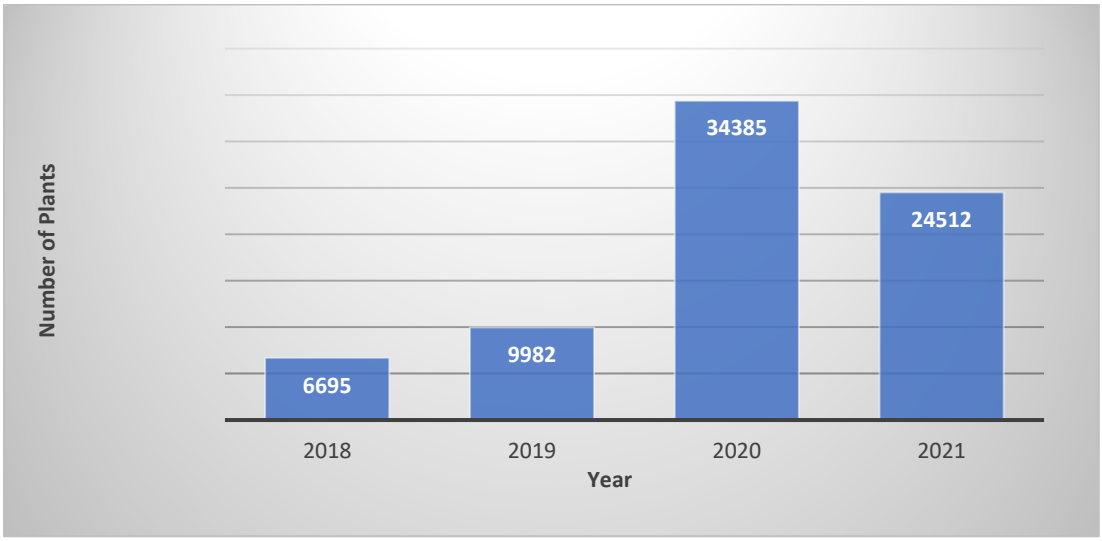

Figure 13. Total number of Pecos sunflower plants in 8 30m x 2 m transects at Milagro Ciénega in Santa Rosa.

Figure 14. Post-fire seedling response of Pecos sunflowers at Milagro Ciénega, April 2020, burned February 2020.

Figure 15. Pecos sunflowers at Milagro Ciénega. Post-fire 2017.

Figure 16. The Milagro Ciénega population of Wright's marsh thistle (*Cirsium wrightii*) has increased from two plants to over 30 individuals, growing in a healthy recovered stand of yellow Indian grass (*Sorghastrum nutans*) in response to restoration efforts.

CHALLENGES

- Careless herbicide applications can lead to dead zones for all plants, spanning many years into the future.
- Pile burning has creating some sterile barren areas that would otherwise be occupied by sunflowers (Figure 17).
- Grazing by Corriente cattle in the immediate vicinity of the fenced Ciénega keep sunflower populations from expanding into adjacent suitable habitat (Figure 18).
- Cleaning of the acequia may create significant disturbances to habitat occupied by all three endangered plants and the endemic invertebrates in the spring run.
- Water from the mound spring in the Ciénega is captured by an acequia which diverts the water away from the Ciénega.

Figure 17. Sterilized soils in response to pile burning in Pecos sunflower habitat at Milagro Ciénega (burned in 2018, photo taken 2021)

Figure 18. Milagro Ciénega 7 months after fencing, fire, and livestock exclusion. Pecos sunflowers outside the fenced area are heavily impacted by Corriente cattle. Chipped piles of removed Russian olives on the upper left.

MILAGRO CIÉNEGA MANGEMENT RECOMMENDATIONS

- Cut and stump herbicide treatment of Russian olives and other invasive woody species needs to be repeated at a minimum of every 5 years.
- Herbicides should be carefully applied with a brush. Herbicide types and concentrations need to be carefully studied to understand possible negative impacts.
- Consider a prescribed burn at a minimum of every 5 years to maintain habitat for Pecos sunflowers.
- Maintain fences in good working conditions to exclude Corriente cattle from the Ciénega during the critical growing season.
- Continue permitting grazing during the off season (November through February).
- Continue the annual population trend monitoring of Pecos sunflowers.
- Consider active monitoring of Wright's marsh thistle, rare amphipods and freshwater snails.
- Consider providing permanent protections through a perpetual conservation easement.
- Promote the Ciénega for educational purposes.
- Engage with the Santa Rosa Acequia Association to ensure acequia operations, including clean-out, do not interrupt the function of the wetlands.
- Become an active member of the Santa Rosa Wetland Alliance to follow recommendations of the Santa Rosa Wetland Action Plan (Quivira Coalition 2021).

3. ROBINSON CIÉNEGA

The Robinson Ciénega is privately owned by Poly and Chano Robinson of Santa Rosa (Figure 19; photo on the left by C. Selby). This approximately 15-acre ciénega is grazed year-round by one or two horses and up to a dozen cattle. The water supply of the Ciénega is supplemented by the landowners with water diverted from the Blue Hole Acequia. This ciénega was significantly overgrown by Russian olives and salt cedar when the Guadalupe SWCD initially treated the site through mechanical removal and piling of the trees in 2016, followed by pile burning (Figures 20 & 21). Pecos sunflowers populations were largely concentrated in an open pasture. Resprout treatment was initiated by the Forestry Division in 2019 and has continued annually through 2021 (Table 1, Figures 22 & 23). Areas of Russian olive and salt cedar remain on the property to provide a privacy screen from a nearby park and to provide shade and cover for livestock. Annual monitoring of Pecos sunflowers along 6 transects has tracked population trends since 2019 (Figure 26). In response to multiple restoration treatments, including significant ground disturbing activities from mechanical treatments, the Robinson Ciénega contains one of the largest stands of Pecos sunflowers in the Santa Rosa area.

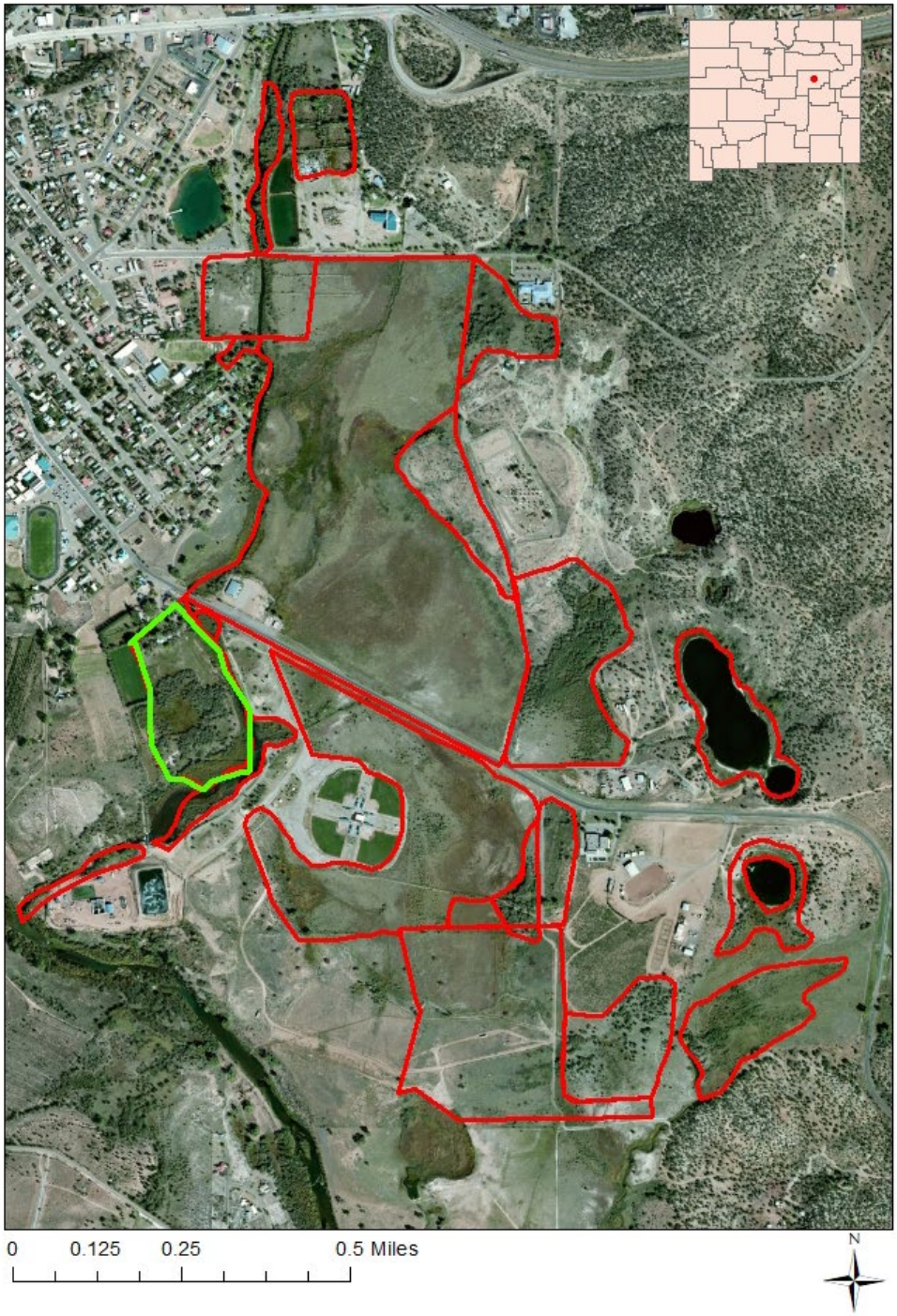

Figure 19. Location of the Robinson Ciénega (highlighted in green) within the treatment areas for the Landscape Scale Restoration Project.

Figure 20. Robinson Ciénega prior to treatment in 2014.

Figure 21. Robinson Ciénega post mechanical removal of Russian olive and tamarisk, piled, but not yet burned (2016).

Figure 22. Robinson Ciénega 2 years after mechanical treatment followed by pile burns (2018).

Figure 23. Resprouts of Russian olives 4 years after initial treatment and multiple resprout treatments at Robinson Ciénega (2020).

Population trend is monitored at the Robinson Ciénega to get a better understanding of treatment and management impacts. Although the number of plants appears to be in overall decline, fluctuations are expected for annual plants between years depending on rainfall

availability during the growing season. In addition, plants in 2 of the 6 monitoring transects were impacted by the vegetation removal project in 2020.

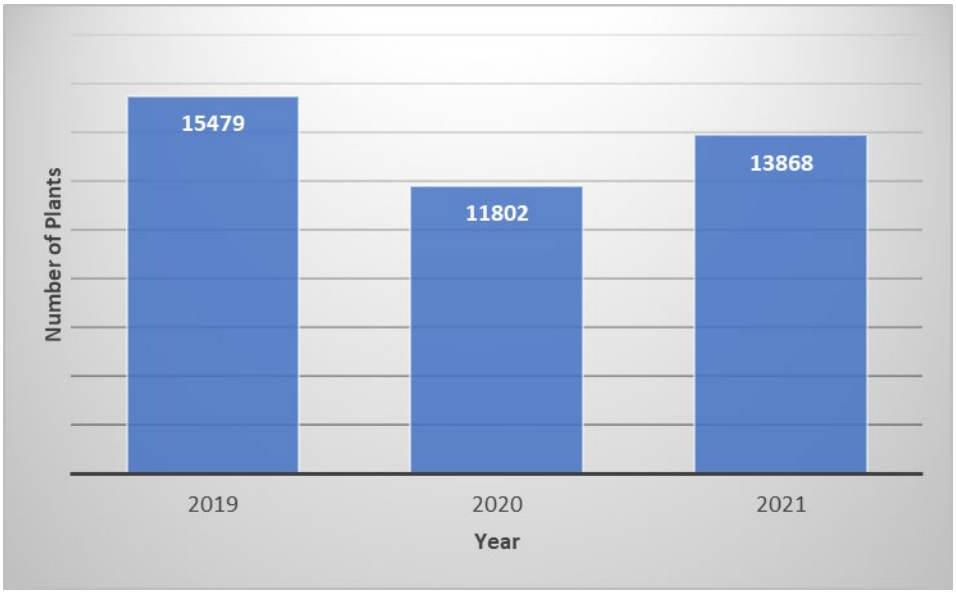

Figure 26. The number of Pecos sunflowers along 6 30 m x 2 m transects at the Robinson Ciénega in Santa Rosa between 2019 and 2021.

The Robinson Ciénega was pile burned initially (2017) but has not been burned since at the request of the landowners. Horses and non-Corriente cattle appear to dislike Pecos sunflowers and have little impact on sunflowers, other than some trampling and very limited grazing. Preferential grazing may improve sunflower habitat by removing the competition of other ciénega plants that are more palatable to livestock. It is likely that limited year-round cattle grazing along with supplemental watering is maintaining this population of sunflowers in the absence of fire.

CHALLENGES

- Persistent tamarisk and Russian olive stands may ultimately reseed the Ciénega and return it to its former condition in the absence of active management.
- Density of sunflowers makes vegetation removal projects challenging and needs to be restricted to October.
- Pile burning has created some sterile barren areas that would otherwise be occupied by sunflowers (Figure 24).
- Year-round grazing of horses and cattle (not Corriente) appears to have little impact of sunflowers (Figure 25).
- The extent to which Robinson sunflower populations depend on supplemental watering is unknown.
- Careless herbicide applications can lead to dead zones for all plants.

Figure 24. Sterilized soils in response to pile burning in Pecos sunflower habitat at Robinson Ciénega (burned in 2016, photo taken 2020)

Figure 25. Horses and non-Corriente cattle appear to dislike Pecos sunflowers and have little impact on sunflowers.

ROBINSON CIÉNEGA MANAGEMENT RECOMMENDATIONS

- Cut and stump herbicide treatment of Russian olives and other invasive woody species needs to be repeated at a minimum of every 5 years.
- Do not add Corriente cattle, or goats, or exceed current stocking rates.
- Herbicides should be carefully applied with a brush. Herbicide types and concentrations need to be carefully studied to understand possible negative impacts.
- Continue the annual population trend monitoring of Pecos sunflowers.
- Consider providing permanent protections through a perpetual conservation easement.
- Salt cedar and Russian olives retained for shade and privacy screens should ultimately be replaced with more suitable tree species that will not become invasive.
- Become an active member of the Santa Rosa Wetland Alliance to follow recommendations of the Santa Rosa Wetland Action Plan (Quivira Coalition 2021).

OVERALL LESSONS LEARNED

- Sunflowers need some form of disturbance to thrive.
- Not all livestock is damaging to Pecos sunflower populations, because sunflowers are not palatable to all types of livestock.
- Herbicide is necessary to control invasive woody species and reduce resprouts, but continued retreatment is necessary even after multiple initial treatments, with no more than 5 years between treatments.
- To prevent leaching and overspray, the use of herbicide should be carefully executed, preferably by brushing it onto the cut surface immediately following cutting of the stems.
- Herbicide concentrations need to be carefully evaluated to avoid damage to the habitat.

- Herbicide can only be used after sunflowers are done flowering and seeding, and before the trees or resprouts lose their leaves, generally during the month of October.
- Pile burning is not recommended in ciénegas because it sterilizes the soils, making it uninhabitable to sensitive plants.
- Due to the proximity of an urban landscape Santa Rosa wetland hydrology is fragile and any manipulation can result in significant changes to ciénega habitats.
- Continued coordination among stakeholders and active management are necessary for long term success.
- Community education and fostering of a conservation consciousness is essential in maintaining community buy-in.

ACKNOWLEDGEMENTS

Restoration of the Santa Rosa ciénegas was and continues to be a collaborative project depending on the dedicated work of agencies and individuals, from researchers to artists, reporters, educators and ranchers. Funding for projects reported here came from the USFWS, a US Forest Service Landscape Scale Restoration Grant, and multiple NM Water Trust Board grants from the NM Finance Authority. Grants were largely administered through Vince Cordova and Gloria Gage at the Guadalupe SWCD and Carmen Austin of the EMNRD-Forestry Division. Treatments were implemented by staff of the EMNRD-Forest Division, including Carmen Austin, and the Inmate Work Camp of the Forestry Division, as well as a variety of contractors, especially Los Arboles of Albuquerque. Special thanks to all the collaborators including the City of Santa Rosa, Christian LeJeune, Polly and Chano Robinson, Mark Micelli, Dale Houlihan, Aaron Davis, Canuto Sanchez, Albert Elevario, Megan Quintana, and the Twin Lakes Country Club. Kudos to M.E. Sprengelmeyer and his staff of reporters at the Santa Rosa Communicator for faithfully printing stories on the Pecos sunflower and the progress of our restoration and monitoring activities, and to Christina Selby and Arturo Anzures for documenting all these activities in their spectacular documentary 'Saving Beauty' and various magazine articles, including the NM Magazine. None of this would have happened without Bob Sivinski, former botanist of the EMNRD-Forestry Division, who first discovered Pecos sunflowers growing at Blue Hole Ciénega. He was the driving force behind the purchase of Blue Hole Ciénega by the Forestry Division solely for the purpose of protecting rare and

endangered plants. Special thanks to Estella Thompson for teaching our youth to appreciate wetlands, Pecos sunflowers, and the importance of plant conservation at home, cumulating in the First Annual Pecos Sunflower Festival in 2021.

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