

Status Report

Arizona Willow (*Salix arizonica*)

Santa Fe and Carson National Forests

New Mexico

2021



Daniela Roth

EMNRD-Forestry Division

for the

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INTRODUCTION



Arizona willow (*Salix arizonica*) is a shrub forming a prostrate mat, large hedge, or thicket several centimeters to 3 m tall (typically less than 8 dm tall) in the willow family (Salicaceae)(NMRPTC 1999). Plants flower from late May to early July before the leaves have fully developed. It produces fruit and mature leaves from June to August. Timing of flowering and leaf emergence depends on elevation and local climate.

Populations are known from north-central New Mexico, southern Colorado, east-central Arizona, and the high plateaus of south-central UT. In New Mexico it is known from Mora, Rio Arriba, and Taos counties. Plants occur primarily on Forest Service lands (Santa Fe and Carson National Forests), but also on private lands.

Arizona willow closely resembles the widespread *Salix boothii* (syn= *Salix myrtillifolia*, *S. pseudocordata*)(NMRPTC 1999). These species are distinguishable in that *Salix arizonica* has broader leaves with rounded to cordate leaf bases, and more teeth per centimeter than *S. boothii*. Genetic differences are currently analyzed by the USGS in Flagstaff, AZ.

HABITAT



Arizona willow occurs in sedge meadows and wet drainage ways in subalpine coniferous forest at elevations above 8,200ft (above 10,000ft in New Mexico). Associated species include *Carex* spp., *Caltha leptosepala*, *Pedicularis groenlandica*; *Trifolium* sp., *Geum macrophyllum*, *Dasiphora fruticosa*, *Dodecatheon pulchellum*, *Taraxacum officinale*, *Phleum alpinum*, *Poa pratensis*, *Salix monticola*, *Salix planifolia*, *Polygonum bistertoides*, and *Deschampsia caespitosa*, bordered by *Picea engelmannii*, and *Picea pungens*.

These high elevation wetland habitats are considered rare in the Intermountain West. Hence the survival of this species depends on future habitat trends and conditions, as well as on the conservation efforts and management provided by land managers. Currently most occurrences in New Mexico are vulnerable to ungulate herbivory and habitat loss or degradation, combined with climate change.

STATUS

Arizona willow was proposed for federal listing under the endangered Species Act in 1992 (57 FR 54747 54766). At that time, it was only known from the vicinity of Mount Baldy in east-central Arizona. New populations discovered in southern Utah in 1994 expanded the known range and Arizona willow was withdrawn from listing in April of 1995, following the development of an Interagency Conservation Agreement and Strategy between the agency stakeholders in UT and AZ and the USFWS (AWITT 1995). Although many of the action items specified in the Conservation Agreement were never completed by the majority of the participating agencies, the agreement was allowed to expire in 2005, due to the discovery of additional populations in New Mexico and Colorado.

Currently Arizona willow is a Forest Sensitive Species in Forest Service Regions 2, 3, and 4 (Arizona, New Mexico, Colorado, Utah). NatureServe gives it a rounded global rank of G2 (imperiled) and the state rank in New Mexico is S1 (critically imperiled). The New Mexico Rare Plant Conservation Strategy gives Arizona willow an overall conservation status of 'Effectively Conserved' with moderate confidence, largely due to number of element occurrences, range size and remoteness of habitat.

Arizona willow is primarily found on Forest Service lands, in New Mexico and elsewhere. Because of the difficulty in determining what constitutes a genetic individual in the field, the total number of plants can only be very roughly estimated. Occurrences in Arizona, Colorado, and New Mexico are generally much smaller than those in Utah (Decker 2006). Population sizes range from one individual to several thousand. In New Mexico populations are generally small and have been estimated to contain from one to over 1,000 individuals (Tonne 2002).

Arizona willow is threatened by prolonged drought and climate change, livestock grazing, wildlife browsing, water impoundments and diversions, roads, recreation, disease, alteration of hydrologic regimes, changes in the riparian community species composition and structure, and invasion of non-native vegetation brought about by historic and current livestock grazing (NMRPTC 1999; Decker 2006). The species is particularly vulnerable due to its limited, fragile habitat. The primary threats for New Mexico populations are browsing by wildlife, especially elk, livestock grazing, and hydrological alterations brought on by overgrazing and climate change. In Arizona populations are also threatened by a rust disease, which can lead to early leaf drop and reduced vigor in infected plants (Fairweather 1993).

Population trends have not been monitored in New Mexico and only intermittently in Arizona and Utah, but the species is in apparent decline throughout its southern range (Tonne 2002, Olmon Phillips 2017).

METHODS

There are 6 metapopulations of Arizona willow known to occur in New Mexico (Cabresto, San Pedro Parks, Sawmill, Pecos Wilderness, Rito de la Presa, and East Fork Rio Brazos). Some of these contain multiple occupied sites documented by a variety of researchers in the past. Exact locations of the older documented sites are often unclear. An attempt was made to visit all

populations described in the 2002 status report for New Mexico, which is the most recent report on the status of the species in New Mexico (Tonne 2002). The 2002 report was based on reports from Robert Dorn (1997) and Duane Atwood (1996). The two older reports did generally not provide an estimated number of plants and locations were estimated. Not all sites could be visited due to washed out or closed roads, wildfire, or the lack of assistance. Additional locational information was provided by the New Mexico Natural Heritage Program and information downloaded from voucher specimen listed on SEINet (<https://swbiodiversity.org/seinet/index.php>).

A total of 20 sites were successfully visited in the Carson and Santa Fe National Forests in 2021 (Figure 1):

Carson National Forest:

Thirteen sites in the Cabresto Park area (D7-1, D7-2, D7-3, D7-4, D7-5, D7-6, D7-7, D7-8, D7-9, D7-11, WPT8, WPT13, WPT14). One site at Cabresto Park was not visited in 2021 (D7-10). It had 18 plants in 1999, but none were found in 2002.

One site along Rito de la Presa above Little Korea, and one site along Sawmill Creek in the Wheeler Peak Wilderness.

One site just north of Rito la Presa, Rito de las Olas, was attempted on multiple occasions from multiple sides, but could not be reached due to road closures and road washouts.

Santa Fe National Forest:

5 sites at the San Pedro Parks Wilderness (Los Pinos Trail/ Rio Puerco, Rito de las Vacas, Rito Anastacio, Clear Creek, Rio Puerco Tributary). The Canyon Madera site in the San Pedro Parks Wilderness was not reached due to time constraints.

Eight sites in the Pecos Wilderness were not visited in 2021. Access is via a multi-day backpacking trip only. Scheduled surveys had to be cancelled due to a nearby wildfire which closed all trails into the area for several weeks. Later attempts were thwarted by the lack of assistance.

One site not included in the 2002 status report but documented from a small tributary of the east fork of the Rio Brazos in the Tusas Mountains (R. Sivinski 5538, 2002) was attempted but could not be reached due to access road wash-out and fallen trees.

Arizona Willow Survey Locations 2021

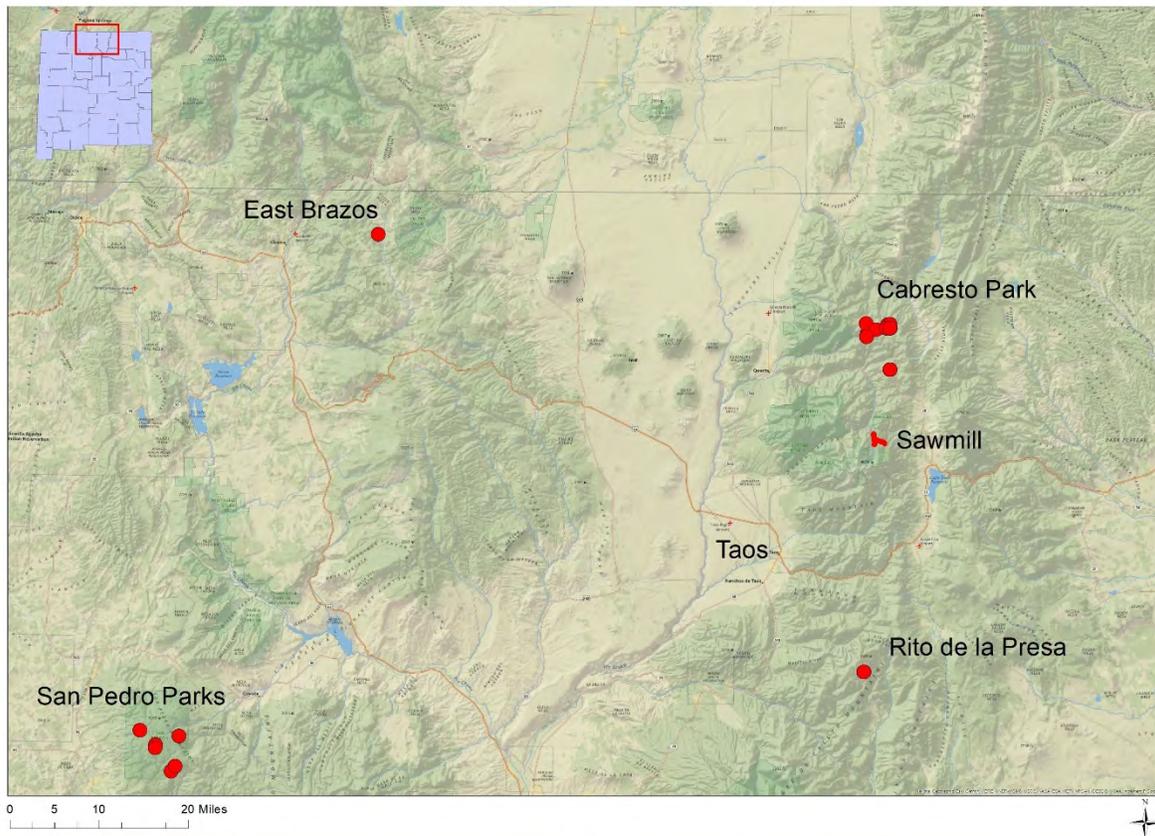


Figure 1. 2021 survey locations for 2021 Arizona willow.

Due to difficulties discerning individuals, plants were considered individuals if stems were more than 1 foot apart. Survey routes were documented using the tracking function of a Garmin Monterra GPS. Waypoints and associated data were collected with a Samsung Galaxy S2 tablet using the Collector App. A waypoint documented the presence of live plants either by actual counts for small sites or visual estimates for larger sites in the vicinity of the waypoint. Additional information was collected on the presence of disease, grazing impacts, enclosure condition (if present), vigor, reproductive status and recent disturbances associated with the general area of occupation.

RESULTS

CARSON NATIONAL FOREST

Three general areas of known occurrences in the Carson National Forest were surveyed, each containing multiple sites of occupied habitat.

1. Rito la Presa (D4-1)

Surveyed: 6/24/2021

Site Condition rank: Fair

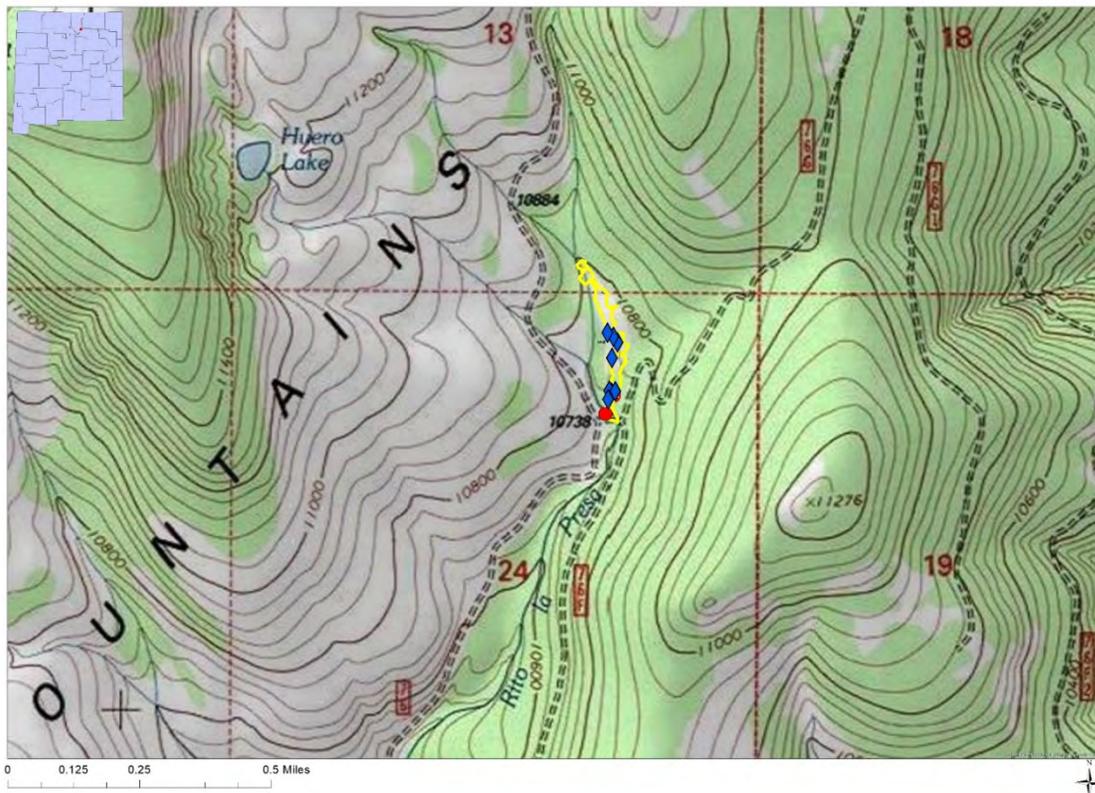


Figure 2. 2021 location of Arizona willow at the Rito la Presa population (D4-1) (blue diamonds). Red circles are previously documented sites, yellow lines indicate areas walked/surveyed.

The Rito la Presa Arizona willow site is a very wet meadow with standing and flowing water. Arizona willow is restricted to a few locations, mapped by 8 waypoints, documenting an estimated 271 individuals, ranging from 3 to 75 plants between waypoints (Figure 2, Table 1). None of the plants were flowering or reproductive. Many were resprouting from the base after an apparent mortality event (dead branches still present) (Figure 3).



Figure 3. Rito la Presa Arizona willow site, 2021. Many willows (*S. arizonica* and *S. planifolia*) with dead aboveground stems, sprouting from the base.

Most plants were infected by an insect gall (Figure 4). There was no sign of rust disease. Diamondleaf willow (*Salix planifolia*) was the dominant willow, many of which also had dead branches and plants were sprouting from the base. There was some evidence of livestock grazing or wildlife browsing, but no livestock was observed at this time. There are several old beaver ponds in this meadow. The lower end has an at-large campsite and off-road tracks into the wetland area. This site was narrowly missed by the 2021 Rainbow Family Gathering camping and festivities that brought thousands of people within a few hundred feet of this site. Protection was afforded by a temporary road closure due to a 2020 fire. The fire did not come near this population, but the road closure was effective just below this population site. Forest roads are located on the east and west side of this population. The area is popular with the OHV community. The majority of plants were considered to be in stressed condition (69%).



Figure 4. Gall infestation on Arizona willow.

2. Cabresto Park

Surveyed: 6/22 - 6/24/2021

Site Condition rank: Fair to poor

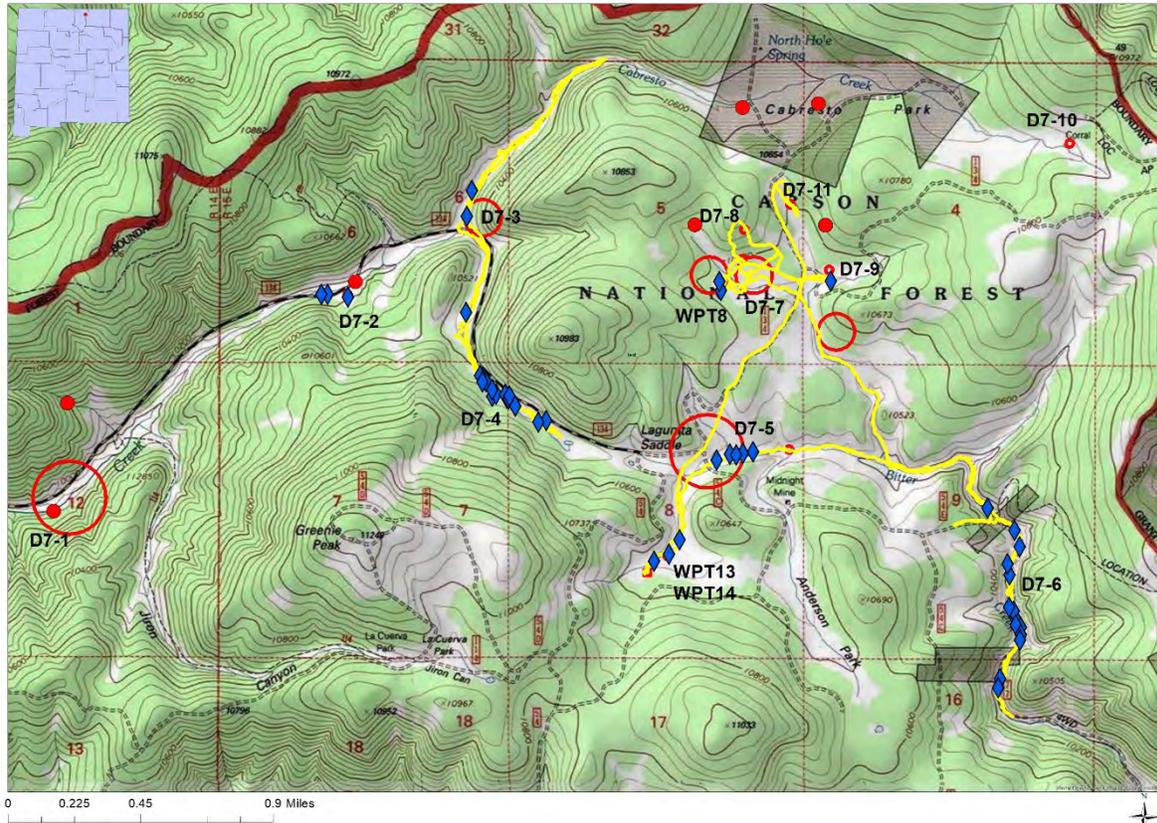
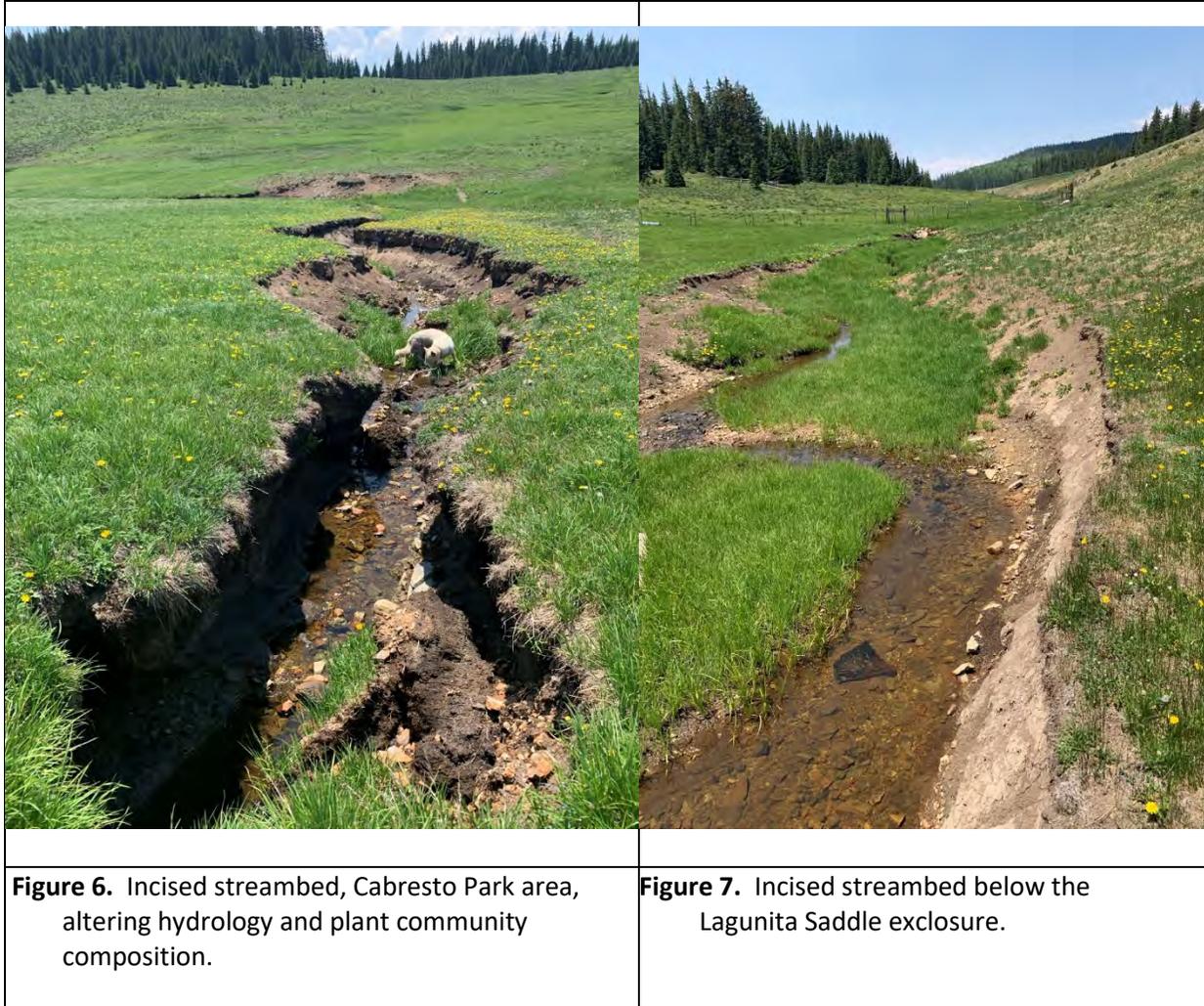


Figure 5. 2021 Cabresto Park sites of Arizona willow (blue diamonds). Red circles are previously documented sites, yellow lines are areas walked in 2021.

Thirteen sites previously reported to support Arizona willow populations were visited in the Cabresto Park area. Suitable habitat along the survey routes was searched for the presence of Arizona willow outside known areas of occupation without success. A total of 698 individuals were documented from 44 waypoints (Figure 5). No plants were found at 4 of the 13 sites (Table 1). Only one of the observed plants was flowering or otherwise reproductive. All documented plants were rated to be in normal condition. No rust disease or other disease was observed during the survey dates. No livestock damage or wildlife browsing was observed. Diamondleaf willow (*Salix planifolia*) was the dominant willow in the extant habitat of Arizona willow. Overall, the condition of the area was poor with many headcuts leading to deeply incised streams throughout the area (Figures 6 & 7). The upland meadows surrounding the remaining willow habitats were dominated by dandelions (*Taraxacum officinale*).



All exclosures in the Cabresto Park area are either defunct or breached, including a fairly recent exclosure near Lagunita Saddle that was likely installed to slow a significant headcut below the fenced area (D7-5) (Table 1, Figure 7). This exclosure is largely intact and stands out in contrast to the surrounding landscape with respect to landscape integrity (Figure 8). A total of 189 individuals were counted inside this exclosure, which is a significant increase over previous counts (Table 1). Multiple former exclosures no longer contained Arizona willow, likely because they were too small and the few plants that might have been contained inside have died, or the habitat no longer supported the willow (D7-7). Most notable among these was a set of 3 large defunct elk & cattle exclosures dating back to 1958 (D7-7). These exclosures were featured in 2002 status report as an example of working exclosures for the protection of the willow. In 2021 the exclosures no longer contained habitat for Arizona willow, likely due to headcuts draining the meadow starting below the exclosures. D7-7 was one of two large populations in 2002 (Table 1). Only two plants were found in the remaining intact habitat nearby (WPT8), one inside the remnants of a defunct exclosure.



Figure 8. Large recently constructed exclosure below Lagunitas saddle. Although breached near the Arizona willow population, which occurs in the upper section of the exclosure, the site was still in good condition in late June 2021 (D7-5).

The largest population of Arizona willow documented in 2021 in the Cabresto Park area was along Bitter Creek (D7-6). 269 individuals were documented from 14 waypoints along the creek and its associated wetlands and seeps. Four of the waypoints associated with Site D7-6 contained plants that might be *Salix boothii* or hybrids (63 of the 269 individuals). These were located at the lower end of the population sites, along Bitter Creek above the Big Five Mine. Arizona willow plants were largely restricted to the streamside and seeps between the remnants of the Big Five (Oro Fino) Mine and the Edison Mine. Much of the Cabresto Park area was once part of the Keystone Mining District containing numerous gold mines and the towns of Midnight City and Anchor. Little remains of these activities, but the associated impacts on the wetland and riparian habitats from 1895 into the 1930s were likely significant and are still noticeable. Notably, no Arizona willows were found in the immediate vicinity of the mines. Restoration activities continue to this day and could have an impact on extant willow sites (ex: potential impacts from the 2010 Big Five removal project). Mining activity remnants are a popular destination for visitors, but drive-in access is currently restricted. OHV traffic was observed throughout the Cabresto Park area along the many Forest roads crisscrossing this area. No plants were observed in the NE corner of Section 9, T29N R15E nor

in the SW corner of Section 4 T29N R15E of the Bitter Creek drainage, as reported by Atwood (1996). Much of this area is heavily impacted by grazing and the stream is incised in multiple locations (Figures 6 & 7). It is likely that the Cabresto population was significantly larger prior to the mining and grazing period.

3. Sawmill Creek (D7-12)

Surveyed: 7/1/2021

Site Condition rank: Good

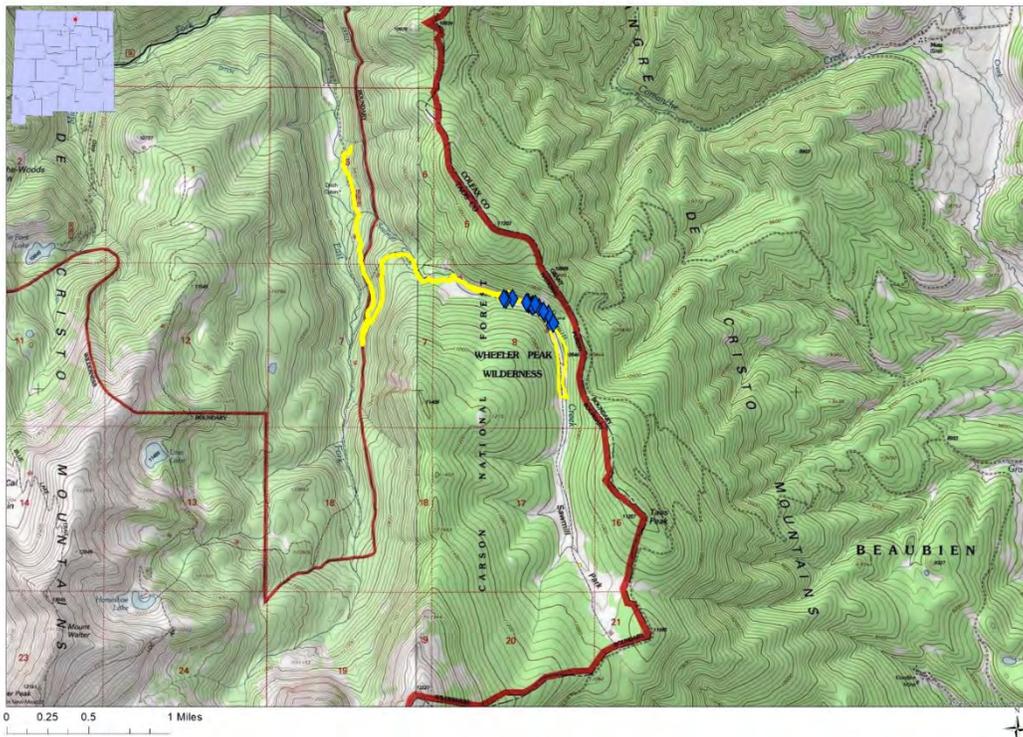


Figure 9. 2021 location of Arizona willow along Sawmill Creek. Yellow lines indicate areas walked/surveyed.

The Sawmill Creek site is a very wet meadow with standing and flowing water. Arizona willow locations were mapped by 20 waypoints, documenting an estimated 183 individuals, ranging from 2 to 20 plants between waypoints (Figure 9, Table 1). None of the plants were flowering or reproductive. Diamondleaf willow (*Salix planifolia*) was the dominant willow. There might be some Booth's willow (*Salix boothii*) along the stream. There was no sign of rust disease. Some willows had tent caterpillars on them. The drier locations were dominated by dandelion (*Taraxacum officinale*), likely brought in by livestock and trail riders. There was no evidence of livestock grazing at the survey dates, but some evidence of wildlife browsing. All plants were considered to be in normal condition.

This population was not mapped in the right location on shape files provided by the Heritage Program. Only Section 8 T27N R15E was surveyed due to time constraints. There are likely more plants in Section 17, T27N R15E.

TABLE 1. Estimated number of Arizona Willow plants at 16 sites in the Carson National Forest in 2002 and 2021 (N/A = not applicable, not in or near an enclosure).

Location/ Site Number	2002 Estimated # of Plants	2021 Estimated # of Plants	Enclosure Intact 2021	2021 Comments
1/D4-1	200	271	N/A	Many resprouting from dead branches, many with galls, plants stressed
2/D7-1	0	0	N/A	None observed in 2002 & 2021; 10 in 1997
2/D7-2	39	9	N/A	Severely trampled
2/D7-3	50	10	N/A	Plants not in enclosure
2/D7-4	400-600	187	NO	
2/D7-5	45-50	189	NO	Enclosure recent, large, breached at top
2/D7-6	164 (1997?)	269	N/A	With <i>S. boothii</i>
2/D7-7	300	0	NO	All 3 enclosures defunct, habitat no longer present
2/D7-8	0	0		1 in 1997
2/D7-9	35	3	N/A	
2/D7-11	0	0		10 in 1997. Only <i>S. planifolia</i> in 2021
2/WPT8	2	6	NO	1 inside enclosure
2/WPT13	1 (few)	22	NO	20 outside enclosure
2/WPT14	>40	3	NO	All outside enclosure
3/D7-12	0	183	N/A	900 in 1997?

SANTA FE NATIONAL FOREST

San Pedro Parks

Surveyed: 6/14 -6/16/2021

Site Condition rank: Poor to Fair

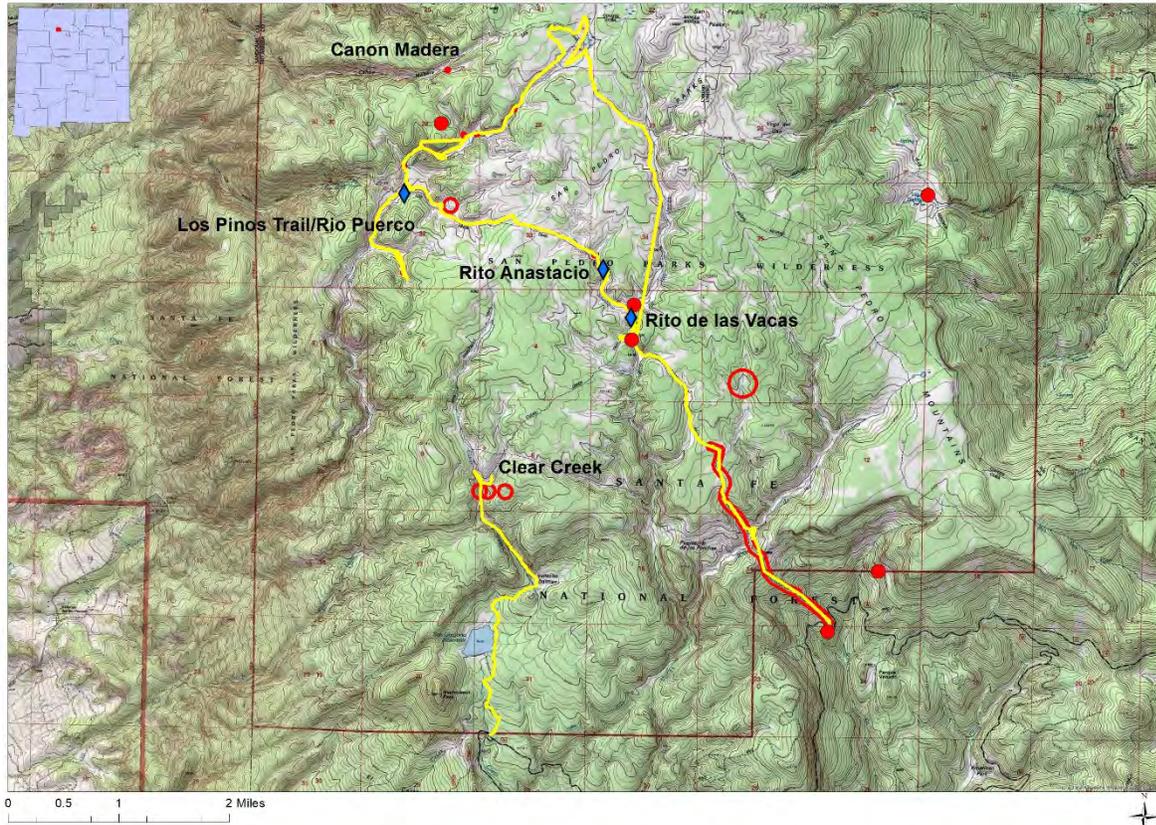


Figure 10. 2021 locations of Arizona willow in the San Pedro Parks Wilderness. Red lines and dots are previously documented areas of occupation (or previously estimated locations). Yellow lines indicate areas walked/surveyed.

Five previously known sites were visited in the San Pedro Parks Wilderness of the Santa Fe National Forest (Figure 10, Table 2). Suitable habitat along the survey route was searched for the presence of Arizona willow outside known areas of occupation without success. Arizona willow sites in this wilderness are extremely small and of questionable viability. Only 18 individuals were found, distributed over 3 locations. None of the plants were flowering or fruiting. Diamondleaf willow (*Salix planifolia*) was the dominant willow. There might also be some Booth's willow (*Salix boothii*) in one of the defunct enclosures at the Rito de las Vacas site. All 3 areas with Arizona willow contained a number of small defunct enclosures, none of them were intact (Figures 11, 12, 13). The wetland habitat was mostly trampled and plants showed signs of browsing (Figure 13). Elk and livestock were observed in the area. None of the plants showed signs of the rust disease or any other disease. Some *S. planifolia* plants were observed with tent caterpillars. No plants were found at the Clear Creek site where downcutting has

rendered the habitat unsuitable (Figure 14, Tonne 2002). Only one *S. planifolia* was found along the banks of the creek, some remnant habitat was observed further downstream, but no Arizona willows were found. Similar results were reported in 2002, with no recovery observed 19 years later. The Canon Madera site was not visited in 2021 due to time constraints. Unfortunately, this was the only site with a population number from previous surveys.

TABLE 2. Estimated number of Arizona Willow plants at 5 sites in the Santa Fe National Forest, San Pedro Parks Wilderness in 2002 and 2021.

Location	2002 Estimated # of Plants	2021 Estimated # of Plants	Exclosure Intact 2021	2021 Comments
Los Pinos Trail/ Rio Puerco	0	2	NO	
Rito de las Vacas	N/A	9	NO	Salix boothii?
Rito Anastacio	N/A	7	NO	
Clear Creek	0	0	N/A	No longer habitat
Rio Puerco Tributary	Several	0	N/A	None found



Figure 11. Tiny defunct Arizona willow enclosure at the Los Pinos Trail/Rio Puerco population.



Figure 12. Defunct Arizona willow enclosure, trampled habitat, and browsed Arizona willow (lower right) at the Los Pinos Trail/Rio Puerco population.



Figure 13. Defunct enclosure with Arizona willow at the Rito de las Vacas site. Note dead stems and plants sprouting from the base. Potentially *S. boothii*.



Figure 14. Habitat conditions at the Clear Creek site. Dominated by dandelion (*Taraxacum officinale*).

DISCUSSION

Only one of the plants was found flowering or fruiting at any of the survey locations at any survey date. This makes identification problematic as the primary differences between *S. arizonica* and *S. boothii* are based on the floral characteristics (NMRPTC 1999; Tonne 2002). Differentiation of these two willow species by vegetative characteristics is somewhat ambiguous. Tonne found that locations in the San Pedro Parks Wilderness contain plants that are more fitting with the description of *Salix boothii* (Tonne 2002). In 2021 at least one of the sites likely contained *S. boothii*. Genetic analysis currently under way at the USGS in Flagstaff, AZ, will shed some light on the taxonomic validity of *S. arizonica*.

The 2002 status report did not reference how plants were identified as individuals, hence making it difficult to compare plant numbers at each site from previous surveys. However, several sites previously reported to contain up to hundreds of plants no longer had any plants and for some the habitat was no longer functional, especially in the Cabresto Park area. A total of only 18 plants were documented from the San Pedro Parks area, from 3 different sites. Although similar low numbers were documented from previous surveys, it is highly questionable whether this can be considered a viable population, especially considering that none of the plants were flowering and all exclosures originally build to protect these plants were long defunct. Either way, exclosures were so small that population expansion would not have been possible. Exclosures were found in the Cabresto Park and the San Pedro Parks area. However, none of them were found intact. Maintenance likely ceased with the completion of the Conservation Assessment and Strategy in the 1990s, despite the fact that plants are listed Forest Sensitive.

Plants should have been flowering or fruiting at all sites during the survey period. No seedlings were observed at any of the locations. The lack of reproductive effort has been observed in Arizona willow populations during prior surveys and from elsewhere and is attributed to trampling by large ungulates, which can physically damage plants and retard normal growth and reproduction (Maschinski 2001, Decker 2006). In addition, insect galls were observed on most plants at the Rito la Presa population. While the damage from galls won't usually kill a willow, it can weaken the tree and may cause early leaf drop, potentially causing a loss of vigor. *Melampsora* rust infections have been documented at several sites in Arizona (Fairweather 1993). Rust infections can also lead to early leaf drop and associated loss of vigor. No rust was observed at any of the Arizona willow populations in New Mexico. However, rust infections are often not apparent until later in the season. 2021 surveys took place in early summer.

Therefore, current surveys may not have observed existing rust infection.

Oystershell scale, *Lepidosaphes ulmi*, is an emerging invasive scale insect that may pose a serious threat to Arizona willow in the future. Although this has been an urban threat since the late 1700s, it has recently spread into natural aspen stands and other trees in northern Arizona (Crouch et al. 2020). The scales damage plants by sucking the sap out of thin barked trees. Heavy infestations can kill plants. Oystershell scale is becoming a problem on aspen, willows, walnut, ash and other tree species throughout the national forests in Arizona (Crouch et al. 2020). Currently there are few sites known from New Mexico, including one from Angel Fire, near the Carson National Forest (J. Formby, pers. com., 2021). Oystershell scale has not been observed on Arizona willow in New Mexico during this survey but should be monitored for.

RECOMMENDATIONS

- Evaluate taxonomic distinction between *Salix arizonica* and *S. boothii*.

If *Salix arizonica* is a distinct species, the following conservation measures should be implemented to prevent further losses:

- Collect seeds for ex-situ conservation and future augmentation projects.
- Consider augmenting existing population from rooted cuttings.
- Monitor populations for impacts from rust disease, oystershell scale and insect galls.
- Implement population trend monitoring at all sites.
- Restore and maintain exclosures. Increase their sizes to allow for population expansion, augmentation, and habitat protection.
- Evaluate trend impacts of exclosures and compare to populations outside the exclosures.
- Evaluate potential habitat mapped by Atwood (1997).
- Clarify USFS mapped areas and list potential habitat vs occupied habitat on shapefiles.

ACKNOWLEDGEMENTS

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