Final Report: Habitat survey, seed collection, and post-fire effects monitoring of Mogollon Death Camas (Anticlea mogollonensis). Submitted by John Moeny, to the New Mexico Native Plant Society, Janurary 2016.

In 2015, I received a grant from the New Mexico Native Plant Society to broaden the current knowledge of, and contribute to, the conservation of a rare New Mexico endemic, *Anticlea mogollonensis*, Mogollon Death Camas. The grant had three goals: 1) find new locations of the plant and delineate the known range of the species; 2) revisit existing sites that burned in the 2012 Whitewater Baldy fire to see how they responded to both the direct effects of the fire and the post-fire watershed treatments; 3) collect seed for ex-situ conservation and propagation. This report summarizes my field work and findings.

Project Background:

Anticlea mogollonensis is a narrowly distributed species endemic to high elevations in the Mogollon mountain range in southwest New Mexico. It is a relatively newly discovered species, being first described in literature in 1995 (Hess and Sivinski 1995). The plant itself is stunning—up to 1 meter tall with nodding, campanulate flowers crowding the raceme. Flower color can be highly variable, from mostly green and tinged with red or purple, to almost entirely dark purple. Individual plants have between 10- 50 flowers and are gregarious amongst each other with specimens numbering in the hundreds on favorable sites. During the summer blooming period, the plant is unmistakable and very showy in its high elevation habitat.

Figure 1. Close-up of *Anticlea mogollonensis* flowers and inflorescence.

Previous reports and collections identify the typical habitat as mixed conifer understory. Following the 2012 Whitewater-Baldy wildfire, much of the mixed conifer forest within the known range of this species burned with high severity, replacing conifer forest with either aspen regeneration or open herbaceous meadows. Little is known about how this plant responds to wildfire, or just how many existing locations may have remained unburned. In 2013 Daniela Roth, the state's endangered plant program coordinator, surveyed known locations to estimate the total number of plants at each site. She was able to relocate most of the known sites and added several more. Her data tallied 17 sites, nearly all within 5 miles of each other and clustered along the Mogollon Crest Trail. Of those, only two or three were unburned in the Whitewater Baldy fire; many more sites were severely burned and covered in thick layers of straw mulch that was applied to prevent soil erosion following the fire. The degree to which the fire and post-fire management has affected *Anticlea mogollonensis* remained relatively unknown. Questions remained as to whether plants that survived the direct effects of the fire would still thrive in a dramatically altered habitat so unlike what is considered typical for the species. There was also a need to find and document any new locations of the species, and also ensure the long-term conservation of this rare and beautiful plant through seed collection and storage.

Project Outcomes:

Two field trips consisting of 5 days each were completed in August and October 2015. Peak flowering for *Anticlea* is typically in mid-August, while seed ripens and can be collected in early October. The August trip was vital for identifying new locations of *Anticlea mogollonensis*, because two other *Anticlea* species (*A. virens* and *A. elegans*) can occur sympatrically. In their vegetative states, all three species can look similar, although *A. mogollonensis* is generally larger than the other two, having longer and broader basal leaves (Flora of North America 1993). Seed collection was completed in October 2015. Nearly every site of *A. mogollonensis* is in the Gila Wilderness requiring miles of foot travel to get to the furthest locations. With many backcountry trails either unpassable or unmaintained, it was slow going getting into areas of potential habitat that had been unsurveyed previously. Still, the field season was successful and I was able to accomplish the goals set forth in the grant.

New Locations and Range Delineation:

During the August trip, searches were made south and west of the known locations along the Mogollon Crest Trail (Figure 2). This trip produced several new locations with one site containing many hundreds of plants. New sites were found in the vicinity of Black Spring and Spruce Creek Divide, and along the ridgeline heading towards Grouse Mountain. These specimens were in high severity burn areas, but where aspen regeneration was patchy. Post-fire vegetation in these areas is typically herbaceous species with *Sambucus* and *Rubus* shrubs also present. A scattering of individuals was found on the trail to Sacaton Mountain in unburned forest. Additional new sites were discovered east of the Mogollon Crest Trail on a long ridgeline heading towards Turkey Feather Mountain. No plants were seen in the more open and park-like habitat around Mogollon Baldy. Data was collected for all new locations including number of individuals, approximate spatial extent of the site, aspect, slope, vegetation community and GPS coordinates. These data were submitted to the NM Natural Heritage Program.

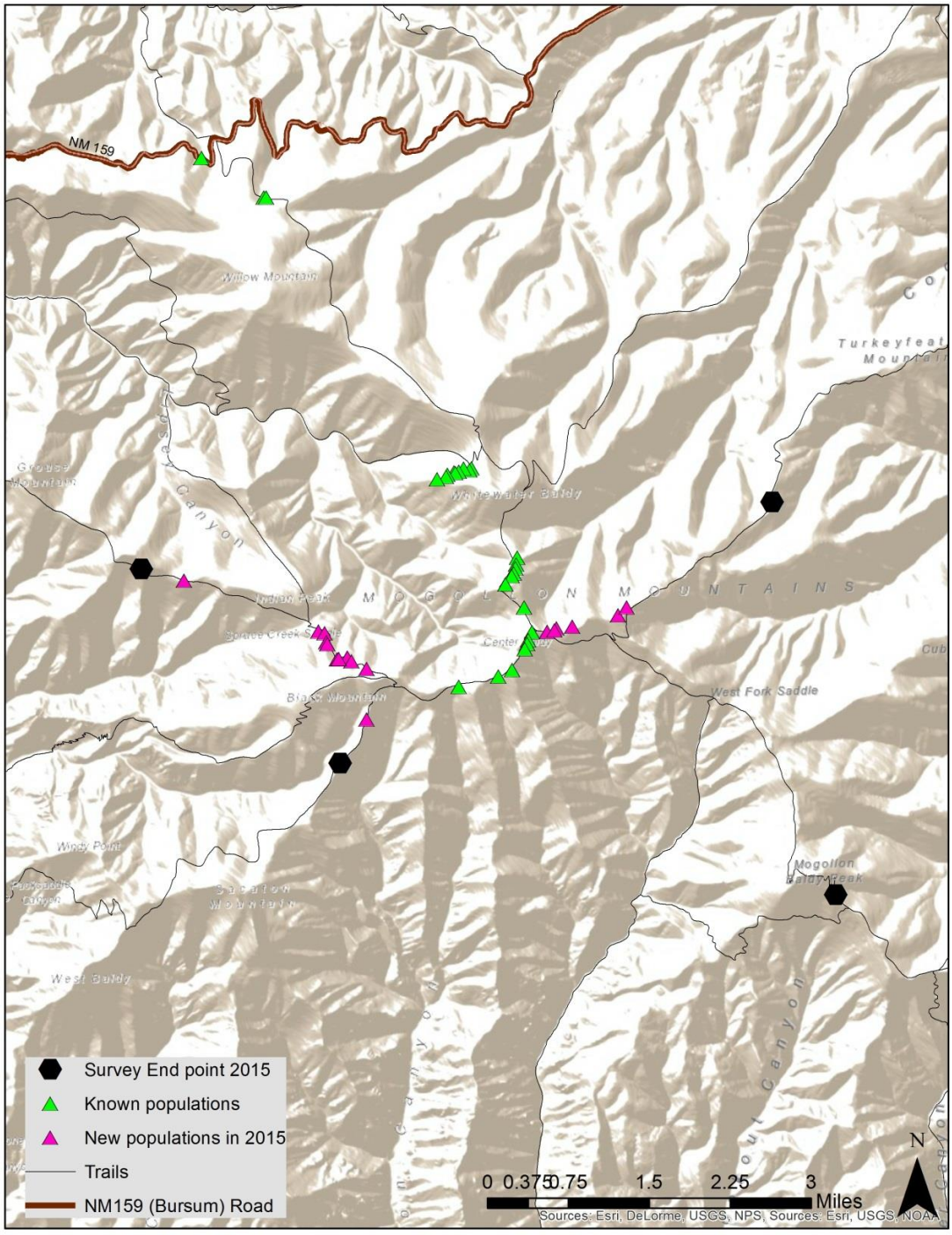

Figure 2. 2015 Survey Area

Nearly all the new sites were found on north facing slopes, or level ridgetops and saddles. This is consistent with other known locations where cooler, wetter aspects are favored. Also consistent with the description of this species, new sites were found on well-developed soils as opposed to areas dominated by cobble and boulder. Interestingly, plants in burned sites continue to persist on soils that still appear "moonscaped" 3 years post-fire.

Anticlea mogollonensis exists in a narrow band of elevation from 9,500 ft. to 10,500 ft. Considering that the high point of the entire area is the summit of Whitewater Baldy at 10,895 ft., the plant is at the upper end of available habitat. Even within the Mogollon mountain range, the suitable habitat appears to be limited. The north slopes of Sacaton Mountain (10,658 ft.) and Grouse Mountain (10,135 ft.) may harbor some plants but were inaccessible for me this summer. Outside the Mogollon mountain range, only a few high elevation areas appear to have the potential for *A. mogollonensis*. Both Bear Wallow Mountain (9,953 ft.) and Eagle Peak (9,786 ft.) are high elevation summits north of the Mogollon range, but *A. mogollonensis* has not been collected at either location despite relatively easy access to both peaks. The core distribution of this species appears to radiate around Center Baldy (10,535 ft.) and the high ridges and slopes within a mile or two of this peak. It is here that one encounters not only the greatest number of sites, but also the greatest abundance of plants per sites as well. This area was severely burned during the Whitewater-Baldy fire of 2012.

Figure 3. *A. mogollonensis* growing in severely burned area.

Fire Effects:

How *A. mogollonensis* has responded to both the fire and post-fire management has been inferred by several lines of observation. The most direct observation is comparing the data collected by Daniela Roth in 2013 at existing locations. I returned to the same locations she surveyed two years previously and recounted the number of specimens at eachsite. The table below summarizes the results of repeat visits in 2013 and 2015.

Site Number	2013 Count	2015 Count	2015 Comment
1-13	46	Did not revisit	
2-13	75	85 (25 in flower)	Thick aspen regen
4-13	2	1	Thick aspen regen
5-13	150	170	
6-13	~200	30	Thick aspen regen
7-13	25	25	
8-13	25	Did not revisit	
9-13	1	1	No seedlings nearby
10-13	10	9	Thick aspen regen
11-13	10	35	
12-13	100s	100s	
13-13	1	7	1 plant at coordinates, 6 more 50’ away
14-13	100s	100s	
15-13	20	30	
16-13	75	120	

Of the 13 sites that were revisited, 6 had increased numbers of plants, 3 decreased and 4 remained the same. Site number 6-13 saw the biggest change with only 30 plants seen in 2015 compared to over 200

in 2013. This site near Hummingbird Spring has very thick aspen regeneration, and the ability to detect plants in 2015 compared to 2013 is considerably lower. A more illustrative site might be number 9-13 , which contains just one individual. This site was severely burned and is still fairly open with little encroachment from aspen or herbaceous ground cover. In 2015 I still saw only one plant, despite spending considerable time searching the nearby area for new seedlings. The location is on a flat ridgetop that was "moonscaped" in the fire and after three years has yet to recover basic groundcover. That *A. mogollonensis* was present just one year after the fire is remarkable and likely a direct result of resprouting from mature plants. Like other members in the family (*Melanthiaceae*), *A. mogollonensis* has a thickened underground bulb with growing points sheltered below ground.

The second, more qualitative line of observation includes observing characteristics like plant vigor, size, numbers of flowers in burned and unburned locations and areas that were treated with mulch following the fire. The response to fire that I observed is somewhat counter-intuitive. The literature for this species clearly describes it as an understory denizen in conifer forest (NM Rare Plant Technical Council, 2002). Locations that experienced stand-replacing fire are now open, treeless habitats with very little, if any canopy cover. These plants look taller, more robust, and have larger and more numerous flowers compared to their unburned counterparts growing within the canopy. Of course, this is a mere 3 years following the fire. What is not known is the long-term stability of the range-wide population. Can individual plants in severely burned areas continue to thrive in open habitats that are undoubtedly hotter and drier? Will new plants be able to establish from seed or vegetatively? What effect will the thick aspen regeneration have on plants in those areas where aspen regeneration is dominant post-fire vegetation? The plants near Hummingbird Spring are somewhat isolated from other locations and are also within some of the most vigorous aspen regeneration. This would be a site worth revisiting to see how well is persists amongst intense competition from aspen.

Following the fire in 2012, several treatments were applied to burned slopes to prevent large-scale soil erosion during the heavy monsoon rains. Over 14,000 acres of steep slopes were mulched via aircraft (Whitewater-Baldy complex fire BAER report, 2012). Many of the mulched areas were also within *A. mogollonensis* habitat. Ideally, the mulch would be applied in a uniform layer several inches thick, but some areas were mulched much deeper- upwards of two feet in several locations. During my visit in 2015, numerous areas were still covered up to 1 foot deep in straw mulch. I did see, however, examples of *A. mogollonensis* growing up through the mulch where very few other plants were able to. It did not appear that the post-fire mulching is posing a serious impediment to the growth of *A. mogollonensis* in the short term. Whether recruitment will occur in these areas remains to be seen, however.

Figure 4. Thick mulch layer from post-fire treatments with *A. mogollonensis*.

While there is reason to be cautiously optimistic about how well *A. mogollonensis* has faired since the fire, it is important to remember that this is a species that has never been collected or observed in open habitats prior to the Whitewater-Baldy fire. While it appears to have been able to survive the direct effects of the fire and post-fire management, additional monitoring should be planned to make sure that plants in exposed, open habitats are able to maintain and expand their numbers as the years progress.

Seed Collection:

Ex-situ seed storage is an important conservation tool for rare plants with a narrow distribution like *A. mogollonensis*. Should additional natural disasters befall populations of this plant, or if new plants are unable to establish in highly altered habitats, it may be difficult if not impossible to reestablish the plant without direct seeding or transplant of container grown specimens. Additionally, given the showy appearance of the plant, it may find success in the nursery trade which would also support the continued survival of this species.

Figure 5. Seeds of Anticlea mogollonensis.

In October 2015, I collected seed from areas that had large numbers of plants per site and that appeared to have recovered from the Whitewater-Baldy fire. Seed was collected by shaking mature seed capsules into a brown paper bag. On most plants there were several stages of capsule maturation, so I was able to take only the ripe seed and leave all unripened capsules and seed on the plant to mature and disperse naturally. Seed from several hundred plants was collected and combined. The total weight, after cleaning was approximately 6 ounces. Based on an estimate of 256,000 seeds per pound, the collection trip yielded approximately 96,000 seeds. These seeds will be divided and sent to both the Desert Botanical Garden in Phoenix, AZ and the Denver Botanical Garden—hopefully they will be able to propagate the plant and include it in their demonstration gardens.

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