

Post-fire Status Report

Heartleaf Groundsel

(Packera cardamine)

Mogollon Death Camas

(Anticlea mogollonensis)



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INTRODUCTION

In 2012, the Whitewater-Baldy fire burned approximately 290,000 acres of forested lands in the Mogollon Mountains of southwestern New Mexico (USFS 2012). The Forestry Division documented the status of 6 plant Species of Concern within one to three years after the fire (Roth 2016). Two of these six Species of Concern had their entire known range burned (Hess fleabane (*Erigeron hessii*) and Mogollon death camas (*Anticlea mogollonensis*)). Goodding’s onion (*Allium gooddingii*), Gila thistle (*Cirsium gilense*), heartleaf groundsel (*Packera cardamine*), and Mogollon hawkweed (*Hieracium brevopilum*) had a significant portion of their known distribution burned by the fire. Although all 6 species were found, the report questioned the persistence over time for 3 plant species that experienced a drastic alteration of their natural habitat which consists of north facing slopes under the canopy of mixed conifer forests above 8,000 feet. Mogollon death camas and heartleaf groundsel are 2 of these 3 vulnerable species that were investigated in 2017 and 2018. Survey results are summarized in this report.

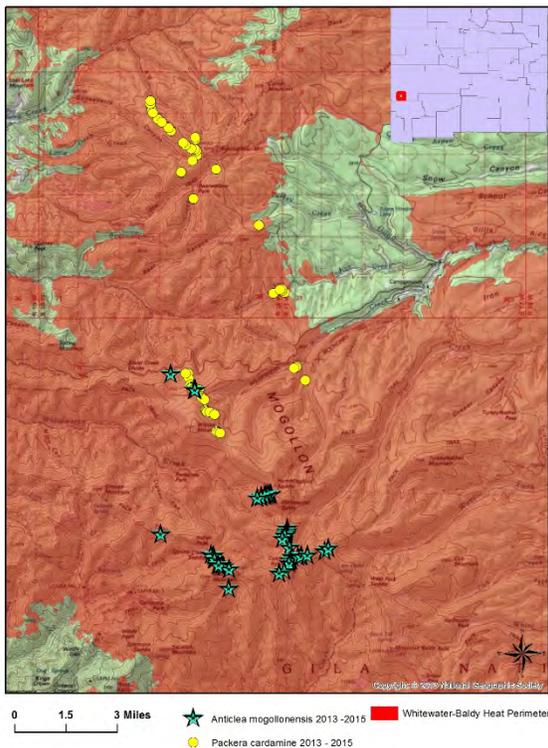


Figure 1. Distribution of heartleaf groundsel and Mogollon death camas within 1-3 years after the Whitewater-Baldy fire in the Gila National Forest, NM.

Heartleaf groundsel

(*Packera cardamine*)



Heartleaf groundsel is a perennial herb in the aster family (Asteraceae). It is only known from the Mogollon Mountains, NM, and the adjacent White Mountains in AZ. It generally grows on steep north-facing slopes and in the forest understory of upper montane coniferous forest between 8,000 and 10,000 ft. It is associated with Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), New Mexico locust (*Robinia neomexicana*), mountain spray (*Holodiscus dumosus*), aspen (*Populus tremuloides*), alpine woodsorrel (*Oxalis alpina*), wild geranium (*Geranium sp.*), nodding ragwort (*Senecio bigelovii*), and Canadian violet (*Viola canadensis*). Heartleaf groundsel is a USFWS Species of Concern, a New Mexico Rare Plant Conservation Strategy Species, and a Forest Service Sensitive species. NatureServe gives heartleaf groundsel an updated conservation rank of S2 (imperiled) for New Mexico (2016). The New Mexico Rare Plant Conservation Strategy considers heartleaf groundsel ‘moderately conserved’ due to low to high threat scores and limited distribution (EMNRD-Forestry Division 2017). The primary documented threats to the species are fire and fire suppression activities. All of the 10 previously documented sites in New Mexico burned in the 2012 Whitewater-Baldy Fire. All of the documented sites in Arizona burned in the 2011 Wallow Fire (538,149 acres). The post-fire distribution and abundance of heartleaf groundsel in Arizona is unknown.

Because heartleaf groundsel has never been observed to grow naturally in open areas, the species may not persist over time in the majority of documented sites on the Gila National Forest due to radical habitat alterations caused by the Whitewater-Baldy Fire. Competition from the aggressive invasive introduced species as well as from the regeneration of native aspen, New Mexico locust, and other deciduous native woody species, was thought to possibly impact some extant sites and habitat of heartleaf groundsel. Between 2013 and 2015, 55 waypoints documented the presence of heartleaf groundsel from 7 general locations within the Whitewater-Baldy Fire perimeter (Roth 2016). Thousands of plants were documented, primarily on steep, north-facing slopes. Plants were found in groupings from a few to thousands of plants. The majority of sites were severely burned with few live trees left. Only one site was documented from an unburned patch.

METHODS

54 of the 55 waypoints documented between 2013 and 2015 were resurveyed in 2018 (Table 1). Previously documented sites along the Crest Trail in the Mogollon Mountains were surveyed in August 2018 following a recent fire in this area (Willow Fire, June 2018; Figure 2). All other sites were surveyed during the flowering period in May 2018. All sites observed in the survey area were recorded using a Garmin Monterra GPS. The number of plants were estimated at each waypoint. A site (waypoint) was considered extant if plants were found within 150 ft of the waypoint recorded in 2013 – 2015. If plants were found outside the 150ft buffer it was considered new. Survey effort was similar to 2013 – 2015 efforts.

RESULTS

Sixteen of the 54 (30%) waypoints documented between 2013 and 2015 no longer contained any heartleaf groundsel plants in 2018, representing the loss of thousands of plants within a few years (Table 1, Figure 3). Plants all but disappeared from the lower reaches of the south fork of BS Canyon. Only 12 plants were documented below 8,800 ft, where thousands of plants were reported in 2015. Plants completely disappeared from the Willow Creek area where plants were reported as common on N-facing slopes in 2013. Except for three of the 16 sites, all had burned severely in the 2012 Whitewater-Baldy fire, resulting in the complete removal of the coniferous overstory and the release of competing vegetation including aspen (*Populus tremuloides*), New Mexico locust (*Robinia neomexicana*), bull thistle (*Cirsium vulgare*), mullein (*Verbascum thapsus*), gooseberry (*Ribes* sp.), wild strawberry (*Fragaria vesca*), raspberry (*Rubus idaeus*), bracken fern (*Pteridium aquilinum*), and a variety of grasses. One site that did only experience a light burn in 2012 and contained hundreds of plants in 2013, Paccar-24b-13, was located in a road cut. It is unclear why plants completely disappeared from the site but may be related to road maintenance activities that have occurred since the site was originally documented in 2013.



Figure 2. Typical heartleaf groundsel at North Fork Mineral Creek.

Plants were found extant at all previously reported sites in the North Fork of Mineral Creek but all were rated small, depauperate and drought stressed (Figure 2). The area burned light to moderately in 2012 and many plants were reported as drought stressed in 2015. One drought stressed site, Paccar-2015-1, reported thousands of plants in 2015 had 350 plants in 2018 (Paccar-1-old-2018). Three new sites were documented from a previously unsurveyed area.

Plants were doing well along the Crest Trail even after the area burned again in 2018 Willow Fire. Fifty-two waypoints documented thousands of plants along the Crest Trail. Seven new sites were documented along the survey route in 2018. Only a small fraction of the documented sites had burned during the 2018 Willow Fire (10%). Only one of the burned sites was burned severely in 2018. The abundance of plants in the vicinity of this site was similar to 2013 values (Paccar-9-13).

Overall 25 new waypoints documented the presence of plants in the burned areas. The majority of new sites were documented from the upper reaches of BS Canyon. It is unknown whether these waypoints represent newly established plants since the 2013 – 2015 surveys, or whether they were overlooked during previous surveys by taking different survey routes through the canyon bottom (no trails). Reasons for this could include the fact that surveys took place during the flowering season in May of 2018, when plants are the most visible. Previous surveys took place in August when only the leaves are visible.

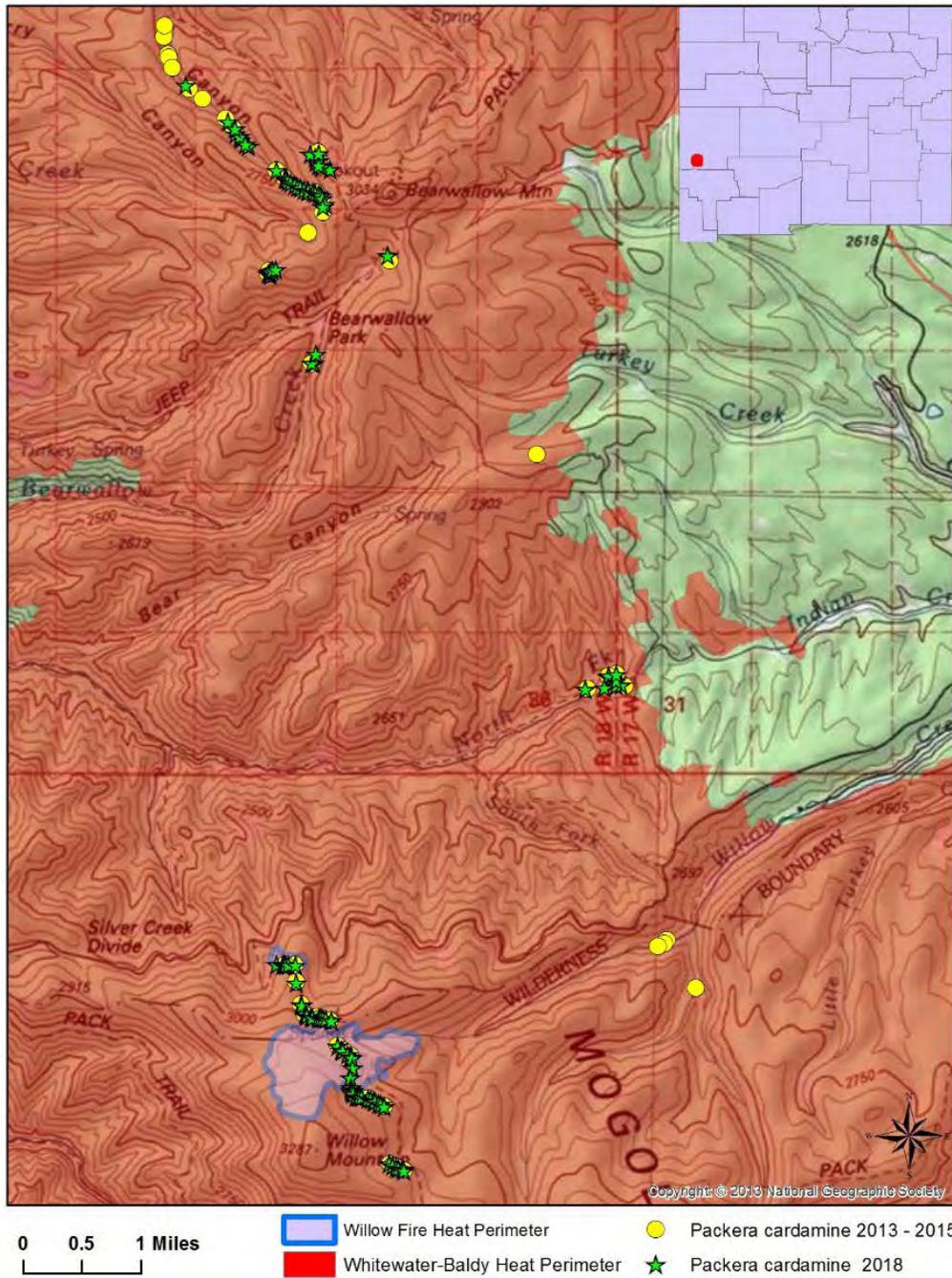


Figure 3. Post-fire changes in distribution of heartleaf groundsel (*Packera cardamine*) between 2013-2015 and in 2018.

Table 1. Estimated number of heartleaf groundsel plants in 2013 and 2015, 2012 fire severity, and the number of plants found in 2018 at each site within the Whitewater-Baldy Fire perimeter.

2013/2015 Waypoint No/	Location	2013/2015 No of	2012 Fire severity	2018 No of plants
Paccar-1-13	Crest Trail	11	Severe	20
Paccar-2-13	Crest Trail	15	Severe	75-100
Paccar-3-13	Crest Trail	20	Severe	20, 30
Paccar-4-13	Crest Trail	30	Unburned	150
Paccar-5-13	Crest Trail	20	Light	35-50, 30
Paccar-6-13	Crest Trail	25	Light	25, 25
Paccar-7-13	Crest Trail	100	Light	10
Paccar-8-13	Crest Trail	30	Light	5, 100
Paccar-9-13	Crest Trail	60	Severe	25, 50
Paccar-10-13	Crest Trail	100	Severe	100
Paccar-11a-13	Crest Trail	150	Severe	35, 50, 30
Paccar-11b-13	Crest Trail	30	Severe	150, 100, 50
Paccar-12-13	Crest Trail	75	Severe	75, 50
Paccar-13-13	Crest Trail	75	Severe	200
Paccar-14-13	Crest Trail	150	Severe	50, 50
Paccar-15-13	Crest Trail	Thousands	Severe	150, 300, 50, 50, 75, 150, 25, 200, 30
Paccar-16-13	Crest Trail	30	Severe	200
Paccar-17-13	Crest Trail	100	Severe	50, 150
Paccar-18-13	Crest Trail	25	Severe	75
Paccar-19-13	Crest Trail	15	Severe	90
Paccar-20-13	Bearwallow	Several	Light	25, 50
Paccar-23b-13	North Fork Mineral Creek	Hundreds	Moderate	100
Paccar-24a-13	North Fork Mineral Creek	100-200	Moderate	50
Paccar-26a-13	Gooseberry	150	Light to moderate	1000
Paccar-2015-2	North Fork Mineral Creek	50-75	Light	15-20
Paccar-2015-1	North Fork Mineral Creek	Thousands	Moderate	150, 200
Paccar-2015-5	BS Canyon	500	Severe	500-600, 100-150
Paccar-2015-6	BS Canyon	500-1000	Severe	100, 75-100, 100-200
Paccar-2015-7	Gooseberry	200	Moderate to Severe	200
Paccar-2015-9	BS Canyon	500	Severe	100-150, 12, 500
Paccar-2015-10	BS Canyon	Thousands	Moderate	1000, 250
Paccar-2015-11	BS Canyon	300-500	Moderate	200
Paccar-2015-12	BS Canyon	200 plants	Severe	1, 2
Paccar-2015-15	BS Canyon	300	Moderate	200, 20
Paccar-2015-16	BS Canyon	Hundreds	Moderate	Hundreds
Paccar-2015-18	Crest Trail	12	Severe	5, 30, 3, 50, 20, 3
Paccar-2015-22	Gooseberry	Hundreds	Moderate to Severe	50-75, 250, 200
Paccar-2015-20	BS Canyon	200-300	Severe	1
Paccar-2015-21	BS Canyon	100	Severe	None
Paccar-2015-19	BS Canyon	50	Severe	None

2013/2015 Waypoint No/	Location	2013/2015 No of	2012 Fire severity	2018 No of plants
Paccar-2015-4	BS Canyon	500-1000	Severe	None
Paccar-2015-8	BS Canyon	750	Severe	None
Paccar-2015-17	BS Canyon	150-200	Severe	None
Paccar-2015-13	BS Canyon	1000	Severe	None
Paccar-2015-14	BS Canyon	200	Severe	None
Paccar-21-13	Bearwallow	75	Light	None
Paccar-23a-13	North Fork Mineral Creek	25	Moderate	None
Paccar-24b-13	Bearwallow Road	Hundreds	Light	None
Paccar-25-13	BS Canyon	100	Severe	None
Paccar-26b-13	Willow Creek	25	Severe	None
Paccar-27-13	Willow Creek	100-150	Severe	None
Paccar-28-13	Willow Creek	Common	Severe	None
Paccar-29-13	Willow Creek	100	Severe	None
Paccar-2015-3	BS Canyon	100	Severe	None
Paccar-2018a	Crest Trail	N/A	N/A	30
Paccar-2018b	Crest Trail	N/A	N/A	20
Paccar-2018c	Crest Trail	N/A	N/A	20
Paccar-1-18	BS Canyon	N/A	N/A	11
paccar-2_18	BS Canyon	N/A	N/A	100-150
paccar-5-2018	BS Canyon	N/A	N/A	50
paccar-6-2018	BS Canyon	N/A	N/A	100
paccar-7-2018	BS Canyon	N/A	N/A	1
Paccar-12-2018	BS Canyon	N/A	N/A	1
Paccar-14-2018	BS Canyon	N/A	N/A	4
Paccar-10c-old-	BS Canyon	N/A	N/A	500
Paccar-10d-old-	BS Canyon	N/A	N/A	400-500
Paccar-15-2018	BS Canyon	N/A	N/A	25
Paccar-16-2018	BS Canyon	N/A	N/A	50
Paccar-17-2018	BS Canyon	N/A	N/A	50
Paccar-25-2018	BS Canyon	N/A	N/A	150
Paccar-26-2018	BS Canyon	N/A	N/A	25
Paccar-28a-2018	Gooseberry	N/A	N/A	Ca 100
Paccar-30-2018	North Fork Mineral Creek	N/A	N/A	10-15
Paccar-31-2018	North Fork Mineral Creek	N/A	N/A	Ca 150
Paccar-33-2018	North Fork Mineral Creek	N/A	N/A	25-35
Paccar-28b-2018	Bearwallow	N/A	N/A	Ca 100
paccar-3-2018	BS Canyon	N/A	N/A	25
Paccar-10-2018	BS Canyon	N/A	N/A	1
Paccar-13-2018	BS Canyon	N/A	N/A	1
Paccar-29-2018	Bear Wallow	N/A	N/A	Ca 150

DISCUSSION AND RECOMMENDATIONS

Population trend can only be surmised from repeat surveys based on plant estimates. Individual plants are difficult to determine due to the rhizomatous nature of the species. In addition, the time of year when plants were surveyed can significantly influence the number of plants estimated. Estimates in 2013 to 2015 were taken during the non-flowering season in August, while 2018 surveys were primarily done during the flowering season in May, which may have resulted in a bias of increased population numbers. Non-flowering plants can easily be overlooked without a more vigorous monitoring protocol counting individuals within a defined sampling area. However, the complete absence of plants from some sites or the significant decline of plants below 8,800 ft is notable and signifies a decline. The decline of plants below a certain elevation is likely the results of habitat alterations created by the removal of the canopy in burned areas and associated increased recovering herbaceous and woody vegetation in combination with prolonged periods of drought, especially during the winter preceding the 2018 surveys. It can be assumed that plants at higher elevation got sufficient moisture to allow them to persist in burned areas despite the increased competition with other plants. Plants were notably absent from the entire Willow Creek area and the lower BS Canyon sites where thousands of plants had been documented in 2013-2015. Extant plants in the North Fork Mineral Creek area were found in a depauperate drought stressed state. All of these sites are below 8,800 ft. The 2018 Willow Fire did not have a significant impact on heartleaf groundsel populations along the Crest Trail. The fire likely burned at low severity due to low levels of fine fuels as a result of the 2012 fire which burned most of the areas severely leaving only large standing or downed dead trees by 2018. Most sites along the Crest Trail appeared unburned by August, although competition from other plants appeared significantly lower along the Crest Trail than in upper BS Canyon which had not burned since 2012. It is unclear to what degree competition from other plants is influencing the abundance of heartleaf groundsel. It is likely that competition may only be a factor when combined with limited rainfall.

Overall there appears to be a decline of populations at lower elevation burned sites. Higher elevation sites appeared to fare better. Considering that most known populations burned in New Mexico and Arizona, the species should be closely monitored on an annual basis by establishing monitoring sites to get a better understanding of population trends as the habitat recovers over time. Unburned areas of the Gila National Forests should be surveyed in the habitat of heartleaf groundsel to ensure continuity of the species should the observed decline in burned areas continue and affect populations currently extant. In addition, seeds should be collected and stored ex-situ to provide for ex-situ conservation and potential future augmentation and reintroduction efforts.

Mogollon death camas

(*Anticlea mogollonensis*)



Anticlea mogollonensis is a perennial herb in the lily family (Liliaceae). It is endemic to the Mogollon Mountains on the Gila National Forest in Catron County, NM. It occurs in the understory of upper montane and subalpine coniferous forest, often with aspen, between 9,000 and 10,500 ft. Associated species include Douglas fir (*Pseudotsuga menziesii*), aspen (*Populus tremuloides*), corkbark fir (*Abies arizonica*), blue spruce (*Picea pungens*), Rocky Mountain maple (*Acer glabrum*), rock spirea (*Holodiscus dumosus*), and a sparse understory of nodding ragwort (*Senecio bigelovii*), wild geranium (*Geranium richardsonii*), thimbleberry (*Rubus parviflorus*), green death camas (*Anticlea virescens*), fleabane (*Erigeron* sp.), fireweed (*Chamerion angustifolium*), bracken fern (*Pteridium aquilinum*) and Canada violet (*Viola canadensis*). No inventory had been completed to document the abundance and distribution of Mogollon death camas prior to the Whitewater-Baldy Fire in 2012, but it had been documented from 5 sites, primarily located in the Gila Wilderness. All of the known sites burned in 2012. Plants were documented in 2013 and 2015, one and three years post-fire. (Roth 2016; Moeny 2016).

Mogollon death camas is a USFWS Species of Concern, a New Mexico Rare Plant Strategy Species, and a Forest Service Sensitive species. NatureServe gives Mogollon death camas a conservation rank of G1/S1 (critically imperiled) (2016). The New Mexico Rare Plant Conservation Strategy considers

Mogollon death camas a ‘weakly conserved’ species due to its extremely limited distribution and documented moderate to high threats scores (EMNRD-Forestry Division 2017). The primary documented threats to the species are fire and fire suppression activities.

Post-fire surveys in 2013 and 2015 documented Mogollon death camas from a total 35 sites in the vicinity of previously documented sites and beyond, along the trails in the Whitewater-Baldy area, over an area stretching approximately 5 miles x 6.5 miles (Roth 2016; Figure 5). Up to several thousand plants were documented from primarily severely burned forest (Table 2). Only six of the 35 documented sites had not burned and plants were located in small patches of unburned forest. The majority of documented sites were located in severely burned forest inside the Gila Wilderness with little or no live canopy present. Because Mogollon death camas has not previously been observed to grow naturally in open areas, the species was feared to not persist over time in the majority of documented sites on the Gila National Forest due to radical habitat alterations caused by the Whitewater-Baldy Fire. In addition, although no invasive species were documented in the vicinity of Mogollon death camas sites, some areas experienced substantial aspen regeneration providing significant resource competition for Mogollon death camas.

METHODS

All but 3 of the 35 previously documented sites were surveyed during the flowering season in August 2017. Surveys targeted 32 sites documented in 2013 and 2015. The number of individuals was estimated whenever plants were found, including previously undocumented sites. All sites (waypoints) observed in the survey area were recorded using a Trimble R1 or Garmin Monterra GPS. The number of plants were estimated at each waypoint. Survey effort was significantly larger than in 2013 and 2015, when only one person was counting and recording individuals. In 2017, 3 people surveyed in the vicinity of previously documented waypoints.

RESULTS

In 2017 4,762 plants were documented from 53 waypoints, including 30 sites documented in 2013-2015. The number of plants ranged from 1 to 970 plants per site (Table 2, Figure 5). At 2 previously documented sites no plants were found. Eight previously undocumented sites were recorded in 2017, adding several hundred more plants to the overall population estimate. It is unknown whether these sites represent newly established plants since the 2013 – 2015 surveys, or whether they were overlooked during previous surveys. Despite increased survey effort and locating plants at most sites, the number of plants was lower than previously documented in the vicinity of many of previously documented sites. A few sites had more plants in 2017 over 2013-2015 values. Plants appeared very healthy and vigorous at all sites and were observed to be generally significantly more vigorous in burned areas than in unburned areas (Figure 4).



Figure 4. Typical growth form of Mogollon death camas in unburned and severely burned forest.



Figure 5. Mogollon death camas distribution in 2013 – 2015, and 5 years post-fire in 2017.

Table 2. Estimated number of Mogollon death camas plants in 2013/2015 and 2017 within the Whitewater-Baldy Fire perimeter.

2013/2015 Waypoint No/ Site Name	2013/2015 No of Plants	2012 Fire Severity	2017 Waypoint No/ Site Name	2017 No of Plants
Antmog-1-13	46	Light to unburned	Antmog-j22-17	37
Antmog-2b-13, Antmog-2015	85	Light	Antmog-j21-17	33
Antmog-4-13	1	Severe	Antmog-2-17	6
Antmog-5-13, Antmog-5-13-end	170	Severe	Antmog-3-17-start, Antmog-3b-17, Antmog-3-17-end	15-20, 109, 150-200
Antmog-6-13	10, 30, 50- 75	Severe	Antmog-4-17-start, Antmog-6-17, Antmog-4-17-end	91, 4
Antmog-7-13	25	Severe	Antmog-7-17	19
Antmog-8-13	25	Severe	Antmog-8-17	8
Antmog-9-13	1	Severe	Antmog-9-17	1
Antmog-10-13	9	Severe	Antmog-10-17, Antmog-10b-17	12, 6
Antmog-11-13	35	Severe	Antmog-11-17	8
Antmog-12-13, Antmog-12-13-end	Hundreds	Severe	Antmog-12b-17, Antmog-12b-17-end, Antmog-12-17-start, Antmog-12-17end	568, 61
Antmog-13-13	7	Severe to moderate	Antmog-13-17	3
Antmog-14-13	50 +	Severe	Antmog-14-17-start, Antmog-14b-17, Antmog-14-17-end	14, 4
Antmog-14-13cont	Couple hundred plants	Severe	Antmog-14-17-cont	113
Antmog-15-13a	30	Severe	Antmog-15a-17	3
Antmog-15-13b	50	Severe	Antmog-15b-17	11
Antmog-16-13	120	Severe	Antmog-16-17-start, Antmog-16b-17, Antmog-16c-17, Antmog-16d-17, Antmog-16e-17, Antmog-16-17-end	685
Antmog_j2_15	3 plants	Unburned	Antmog-22-17	2 plants
Antmog_j3_15	14 plants	Light	Antmog-21-17	10 plants
Antmog_j4_15	1 plant	Moderate	Antmog-20-17	None
Antmog_j5_15	4 plants	Moderate	Antmog-19-17	None
Antmog_j6_15	50 plants	Severe	Antmog-18-17-end, Antmog-18-17-cont, Antmog-18-17-start	970 plants
Antmog_j7_15	Hundreds	Severe		Part of j6_15

2013/2015 Waypoint No/ Site Name	2013/2015 No of Plants	2012 Fire Severity	2017 Waypoint No/ Site Name	2017 No of Plants
Antmog_j8_15	Hundreds	Severe		Part of j6_15
Antmog_j9_2015	Hundreds	Severe	Antmog-17-17-start, Antmog-17-17-end	964
Antmog_j11_15	50	Unburned	Antmog-j11-17, Antmog-j11b-17	59, 64
Antmog_j13_15	8	Unburned	Antmog-j13-17	10
Antmog_j12_15	Dozens	Unburned	Antmog-j12-17	112
Antmog_j14_15	25	Burned to unburned	Antmog-j14-17	21
Antmog_j15_15	60	Burned	Antmog-j15-17	113
Antmog_j16_15	30	Severe	Antmog-j16-17	57
Antmog-2015, Antmog-2b-13	3, 85	Lightly burned/unburned	Antmog-j21-17	33
N/A	N/A	N/A	Antmog-j17-17	2
N/A	N/A	N/A	Antmog-j18-17	10
N/A	N/A	N/A	Antmog-j19-17	21
N/A	N/A	N/A	Antmog-j23-17	5
N/A	N/A	N/A	Antmog-13b-end-17	148
N/A	N/A	N/A	Antmog-13b-17	53
N/A	N/A	N/A	Antmog-15c-17	32
N/A	N/A	N/A	Antmog-j20-17	31

DISCUSSION AND RECOMMENDATIONS

Despite increased survey efforts and generally more vigorous and easier to find plants, it is possible that there is an overall decline from 2013 & 2015 values. No plants were found in two previously documented sites. However, the number of plants was very small in 2015 (1 and 4 plants respectively). These could have been non-flowering or therefore easily overlooked, or they were gone. Trend can only be surmised from repeat surveys based on plant estimates rather than rigorous monitoring of established sample sites. In 2013 and 2015 no counts were taken when more than 100 plants were encountered. Non-flowering plants can easily be overlooked without a more vigorous monitoring protocol counting individuals within a defined sampling area that can be resurveyed on an annual basis to determine population trend. New plants documented from 8 sites in 2017 were mostly located between or adjacent to previously documented sites (Figure 5). These sites added several hundred more plants to the overall population. It is unknown whether these are newly established plants or whether they were previously overlooked. Potential competition from herbaceous and woody vegetation was overall higher in 2017 than observed between 2013 and 2015. However, aspen had not grown significantly.

Mogollon death camas should be closely monitored on an annual basis by establishing monitoring sites to get a better understanding of population trends as the habitat recovers over time. Most of the available habitat in the Gila National Forest burned in the 2012 Whitewater-Baldy Fire. Some plants have been found in unburned patches within the fire perimeter. Unburned areas above 9,000ft in the Gila National Forests should be targeted for surveys in the habitat of Mogollon death camas to possibly expand the known range and make the species less vulnerable to declines caused by habitat alteration and stochastic

extinction events caused by wildfires. In addition, annual monitoring of sample sites needs to be established to determine whether the observed possible declines in burned areas continue and affect populations currently extant. If sample populations show a declining trend over time population augmentation and introductions should be considered. A significant number of seeds were collected in 2015 and deposited at the Desert Botanical Garden in Phoenix, AZ, and at the Denver Botanical Garden in Denver, CO (Moeny 2016). Stored seeds should provide for ex-situ conservation and potential future augmentation and reintroduction efforts.

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