

Fuel Reduction and Restoration of the Golden Chariot Fire, Craters of the Moon National Monument and Preserve 2012

BACKGROUND

Craters of the Moon National Monument and Preserve (CRMO) is recognized for its vast but harsh volcanic landscape. Only plants able to compete for scarce resources and extreme exposure are able to establish and this is restricted mostly to the older lava flows where soils are more established. Seemingly stable, CRMO's interconnected sagebrush stands are subject to large scale disturbances and wildfires, though rare, do occur throughout Craters of the Moon NM. Over the last twelve years, six wildfires have occurred across NPS lands totaling 2,000 acres.

Although wildfire risk is generally low, wildfires that do occur can create a serious resource risk for the CRMO lands that immediately surround them. In all six previous wildfires of recent record, cheatgrass, a nonnative annual grass that outcompetes native plants for early season resources, has invaded CRMO's near-pristine sagebrush shrubland and scattered woodland communities, most likely because seeds and scattered plants were already present before the fire. Though prefire vegetation seems incredibly resilient, native plants are slow to return post fire and are then under constant competitive pressure by cheatgrass and other fine fuels. Curing early in the summer, this cheatgrass component creates an understory of fine fuels that can readily ignite and spread. Areas with cheatgrass then threaten surrounding intact areas where and when future wildfires occur.

This cheatgrass invasion was a particularly surprising result for the Golden Chariot Fire of 2000. Burning four days in mid-September, preburn vegetation of these 180 acres along interstate highway 20/26/93 was characterized as the 15,000 acres that surrounded it - mountain big sagebrush with high understory cover of native perennial forbs and bunchgrasses. The area was expected to respond favorably to passive management because of high preburn native plant cover and the site's higher elevation and precipitation regime. Unfortunately, cheatgrass came to dominate the site's lower swales with deeper soils. Ten years later cheatgrass is scattered throughout but more critically it actually dominates one-sixth of the burned area.

In the summer of 2010, park staff mapped weed patches where cheatgrass represented over 75% of the total plant cover. In total, 15 acres were identified as needing significant rehabilitation and 10 more acres were identified as needing lesser management input (i.e. spot treatments) (see figure 1). Without intervention, these cheatgrass patches will continue to impact native recovery of the site, maintain a highly flammable fuel condition, and serve as vectors for future fires on surrounding lands.

The area of the Golden Chariot Fire is extremely important to park managers at CRMO for several reasons. Primarily, the entire area is currently being utilized as a display lek by one of southern Idaho's largest populations of Greater sage grouse, a species "warranted but precluded" for the endangered species list. A high count of 200 birds was observed on the lek in 2008. Recent surveys report significantly lower numbers though this downward trend is occurring statewide. Also, this larger community type represents some of the most intact sagebrush communities across the entire

Monument and Preserve. CRMO has identified a latitudinal gradient in ecological condition where CRMO's northern 25% of existing sagebrush shrublands appear to be pristine or near pristine, particularly where they have been isolated by newer lava flows (i.e. kipukas). Pristine sagebrush has become increasingly rare throughout the Snake River Plains and the larger Great Basin region due to weed invasion, altered fire regimes, agriculture, improper livestock grazing, and human development. The National Park Service (NPS) needs to act now to adaptively restore the area burned by the Golden Chariot Fire before it provides a fine fuel source to other fires.

CURRENT PROJECT

Funding was sought through the NPS Pacific West Region's regional fuels program to address the fine fuels that continue to impact the recovery of the Golden Chariot Fire. The project aimed to accomplish four objectives: 1) aggressive reduction in fine fuels across the entire burn, 2) augmentation and reestablishment of native species, 3) by way of the first two objectives, reduction in fire risk to the previously burned area and 15,000 acres of surrounding shrublands, and 4) use of this project as a means to develop prescriptions for future fire rehabilitation.

Objective 1: Reduction of Fine Fuels

CRMO has an active weed management program and has been perfecting control methods for its most problematic weeds for over 10 years. Admittedly however, the park has done little with the broad scale treatment of invasive annual grasses such as cheatgrass. Now, much research and experimentation has been conducted throughout the Great Basin U.S. on the broad use of preemergent herbicides on cheatgrass and Plateau[®] herbicide, a BASF product, appears to provide the most effective and consistent control. However, both invasive and native responses to this herbicide is highly variable depending on but not limited to, soil type, cover of cheatgrass and previous year's thatch, cover and type of existing native plants, method of application, and weather conditions before, during, and immediately following application. Broad application of this herbicide is limited to a handful of NPS units across the western U.S. (namely Zion N.P.) and it was unknown how low rates of herbicide would affect residual native grasses. It was also unknown how this herbicide would perform on the rockier terrain of Craters of the Moon NM&P.

To address this issue of a lack of local expertise coupled with a desire to achieve the lowest rate possible for environmental concerns, we felt it was necessary to use funds from this project to apply two slightly different rates of herbicide to determine how "low we could go" and still get effective control. We selected areas that would receive a "higher" rate of 6 ounces of active ingredient per acre (ai/ac) and a "lower" rate of 5 ounces of active ingredient per acre (ai/ac) (see figure 1).

To achieve the first project objective, we obtained an 8-person contract crew through the Utah Conservation Corp (UCC) to assist park staff in applying herbicides to mapped treatment areas. Preemergent herbicides ideally should be applied in the fall after cheatgrass has begun germinating, when native plants are fully dormant, and while temperatures remain above 32 degrees F (typically mid to late October for our area). UCC work crews applied Plateau treatment areas from October 24th through October 31st (see figure 2). Nearly 12 acres were treated. Herbicides were applied using



Golden Chariot Fire

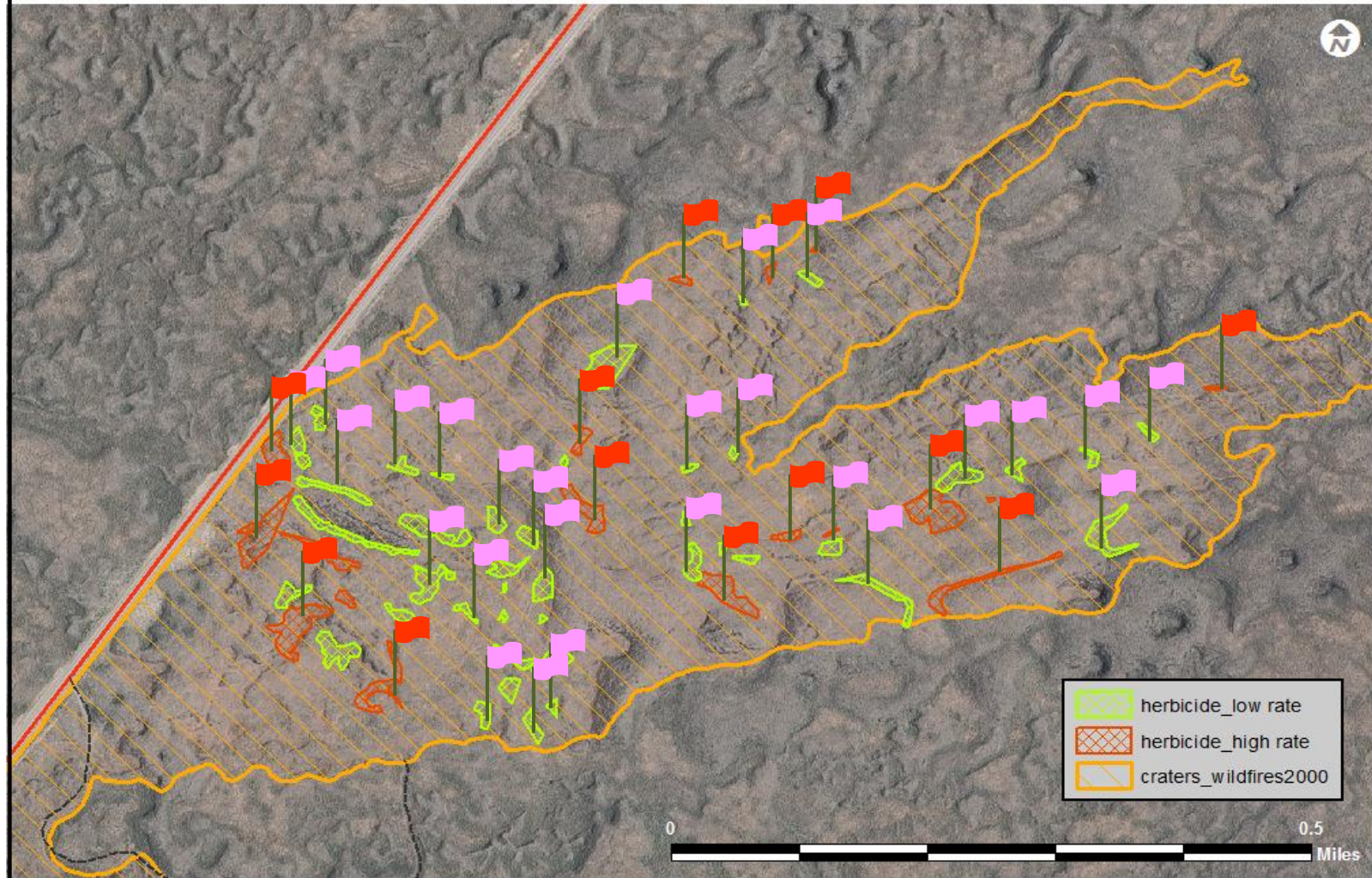


Figure 1. Map of herbicide treatment areas across the 2000 Golden Chariot Fire. Areas were selected at random for herbicide rate and red and pink pin flags were placed at the center of each treatment area to orient spray crews.



Figure 2. Utah Conservation Corp crew members using boom sprayer attachments to apply Plateau® herbicide with added surfactant and biodegradable blue dye to treatment areas in October 2012.

purchased two and three nozzle boom sprayer attachments fitted to 4-gallon backpack sprayer wands. Other than large shrubs and rocks that needed to be walked around for even and consistent herbicide coverage, all vegetation was sprayed as opposed to weaving around dormant native plants. This was an attempt to mimic broader forms of application technique (all-terrain vehicle, helicopter, etc.) that might be used in the future where possible.

Objective 2: Reestablishment of Native Species

CRMO fully recognizes that single weed control treatments alone cannot completely remove fine fuels and return sagebrush shrublands to their predisturbance conditions. Native plants must be reintroduced to make use of the newly freed resources. This is by far the most challenging task of any restoration attempt. We conducted four separate activities to meet objective #2:

- 1) Establish a relationship with the U.S. Forest Service Lucky Peak Plant Nursery out of Boise, ID and have them raise 1,000 sagebrush seedlings for outplanting into areas treated by objective #1. Lucky Peak Nursery, a supplier of seedlings for reforestation projects after natural disasters since 1961, recently began raising local high desert shrubs, grasses, and forbs for restoring southern Idaho rangelands. Mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*) seeds collected from the Golden Chariot site in October 2011 were sent to Lucky Peak Nursery in November of 2011 for cleaning to raise 1,000 locally adapted bareroot plants for outplanting.
- 2) Continue a relationship with the Natural Resource Conservation Service (NRCS) Plant Materials Center out of Bridger, MT to clean seeds destined for broadcast seeding into areas treated by objective #1. We modified an existing agreement with the NRCS to send them approximately 30 pounds of bulk seed materials collected throughout the summer of 2011 by park staff. Grass species were collected that will readily compete with cheatgrass upon germination.
- 3) Utilize the same contract crew through the Utah Conservation Corp (UCC) to plant bareroot sagebrush into mapped treatment areas (see figures 3 and 4). Bareroot planting of desert shrubs in

the fall prior to snowfall has been found to greatly improve establishment following wildfire. Local southern Idaho BLM offices have been utilizing this practice for a number of years and report a consistent 30- 40% survival and above compared to highly variable aerial broadcast seeding efforts that may provide equal success only on a good (lucky) growing year (Twin Falls BLM District fire ecologist, personal communication, 2010). Twelve years following the Golden Chariot Fire, sagebrush, once 60% of the total plant cover, has still yet to significantly recolonize the area. In late October, Lucky Peak Nursery delivered by mail over 1,250 9-month old plants two days prior to planting. Not every treatment area could be sagebrush planted because we opted for a minimum of 50 plants per planting area for adequate competition for freed resources. With just over 1,250 plants delivered, 25 of the nearly 40 treatment areas were planted in a haphazard fashion.

- 4) Utilize the same UCC crew to assist park staff in broadcasting cleaned native grass seed into select treatment plots. Revegetation attempts across western rangelands are most successful if they can physically bury seeds below the soil surface. This is typically achieved through the use of a rangeland drill, cultipacker, etc. Though ideal, this isn't possible across the Golden Chariot Fire; the area is far too rocky to maneuver. Hand raking was also considered but this wouldn't be practical at a larger scale. Instead, simple broadcasting was attempted using seed densities much larger than what is typical. Table 1 lists the seeds used, the two mixes applied, chosen seed densities, and the calculations needed to determine how many areas could be seeded. Only two 5-m² areas could be realistically seeded per treatment area and plots were selected that were within the treated area, had low native cover, and had adequate soil for seeding establishment. Mix A or mix B were selected at random (see figure 5). Plots were hand seeded approximately one week following herbicide treatment and sagebrush planting.

Objective 3: Reduced Fire Risk

This objective is and will remain difficult to demonstrate. To our knowledge no upper limits of cheatgrass presence or cover have been established to actually prove a treated area and the surrounding landscape is at lower risk of fire. For this effort, it stands to reason that if these fine fuels were reduced to say, 10% of their original pretreatment cover that fire risk will be significantly reduced at least in the short term. Any establishment of native revegetation would ostensibly work to actually increase fire risk given that it adds plants/fuels/continuity to the postfire environment. However, if say 40-50% of our revegetation efforts (planted sagebrush and broadcast seeds) were to successfully establish, a large amount of resources would be captured to lower overall fine fuel reinvasion, the connectivity of flashy fuels, and overall risk in the long term. One cautionary note is that successful establishment of native plants from seed can take anywhere from 1-3 years so the success of this objective may not be fully determined one year post treatment.



Golden Chariot Fire

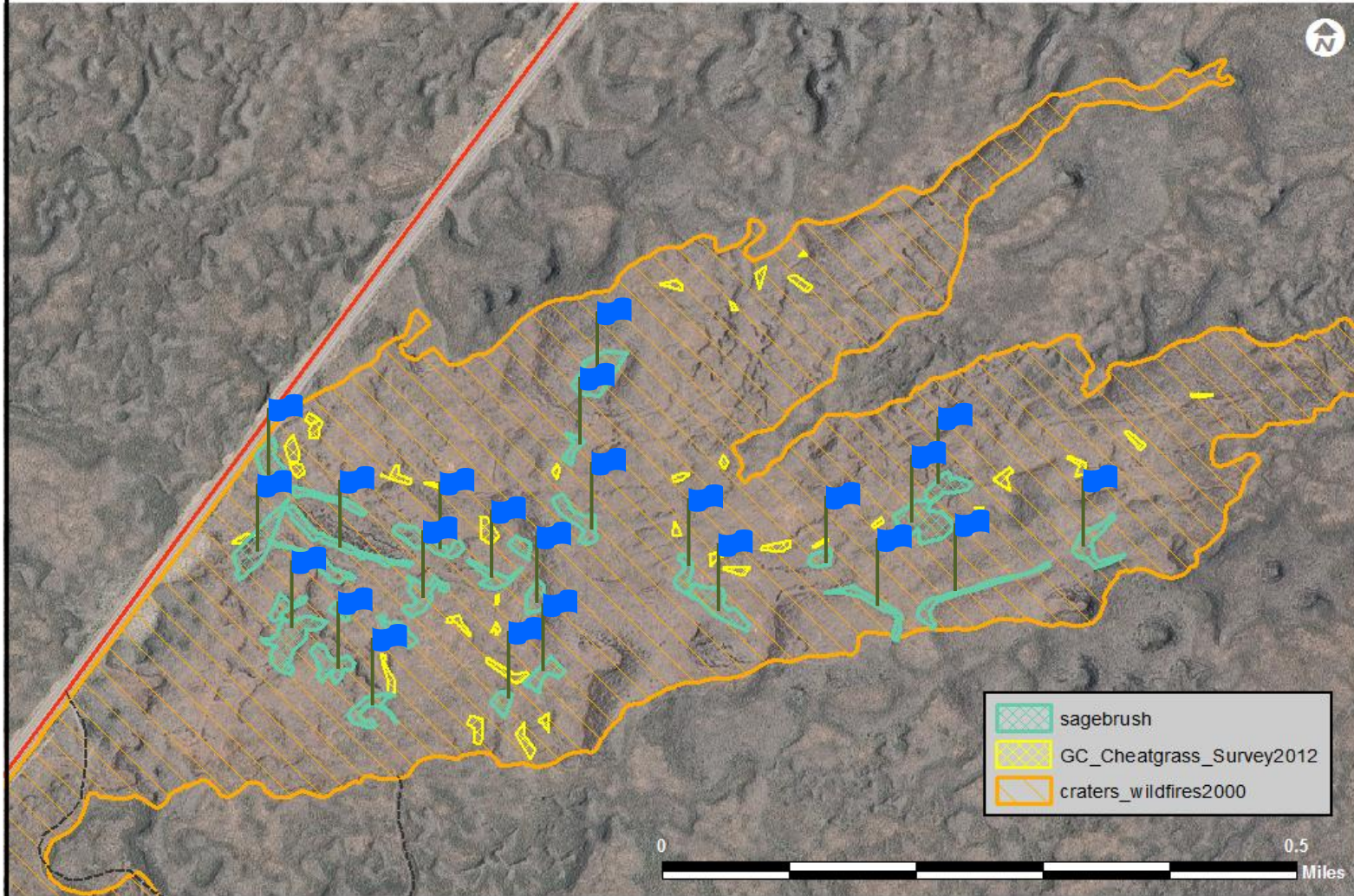


Figure 3. Map of sagebrush planting areas across the 2000 Golden Chariot Fire. Areas were selected at random for planting and blue pin flags were placed at the center of each treatment area to orient work crews.



Figure 4. Utah Conservation Corp crew member hand planting bareroot mountain big sagebrush plants into a treatment plot in late October 2012.

Table 1. Seed mixes broadcasted into one of two treatment plots per treatment area at the Golden Chariot Fire in November of 2012. Note shortage of squirreltail seed meant 7 patches did not receive this species.

Mix	Species		Patch Size (in ft ²)	Seeds / ft.	% PLS	Seeds / lb	Seed Needed (lbs)	Total lbs available	lbs to use	# of Patches
A	Basin wildrye	<i>Leymus cinereus</i>	269.10	60	0.90	144,000	0.125	10.18	3.125	25
	Thurbers needlegrass	<i>Achnatherum thurberianum</i>	269.10	20	0.90	225,000	0.027	0.972	0.675	25
	Squirreltail	<i>Elymus elymoides</i>	269.10	20	0.90	192,000	0.031	0.555	0.555	18
B	Sandberg bluegrass	<i>Poa secunda</i>	269.10	80	0.90	1,047,000	0.023	3.937	0.575	25
	Bluebunch wheatgrass	<i>Pseudoroegneria spicata</i>	269.10	30	0.90	125,700	0.071	1.776	1.776	25
	Indian ricegrass	<i>Achnatherum hymenoides</i>	269.10	20	0.85	162,000	0.040	1.540	1.000	25

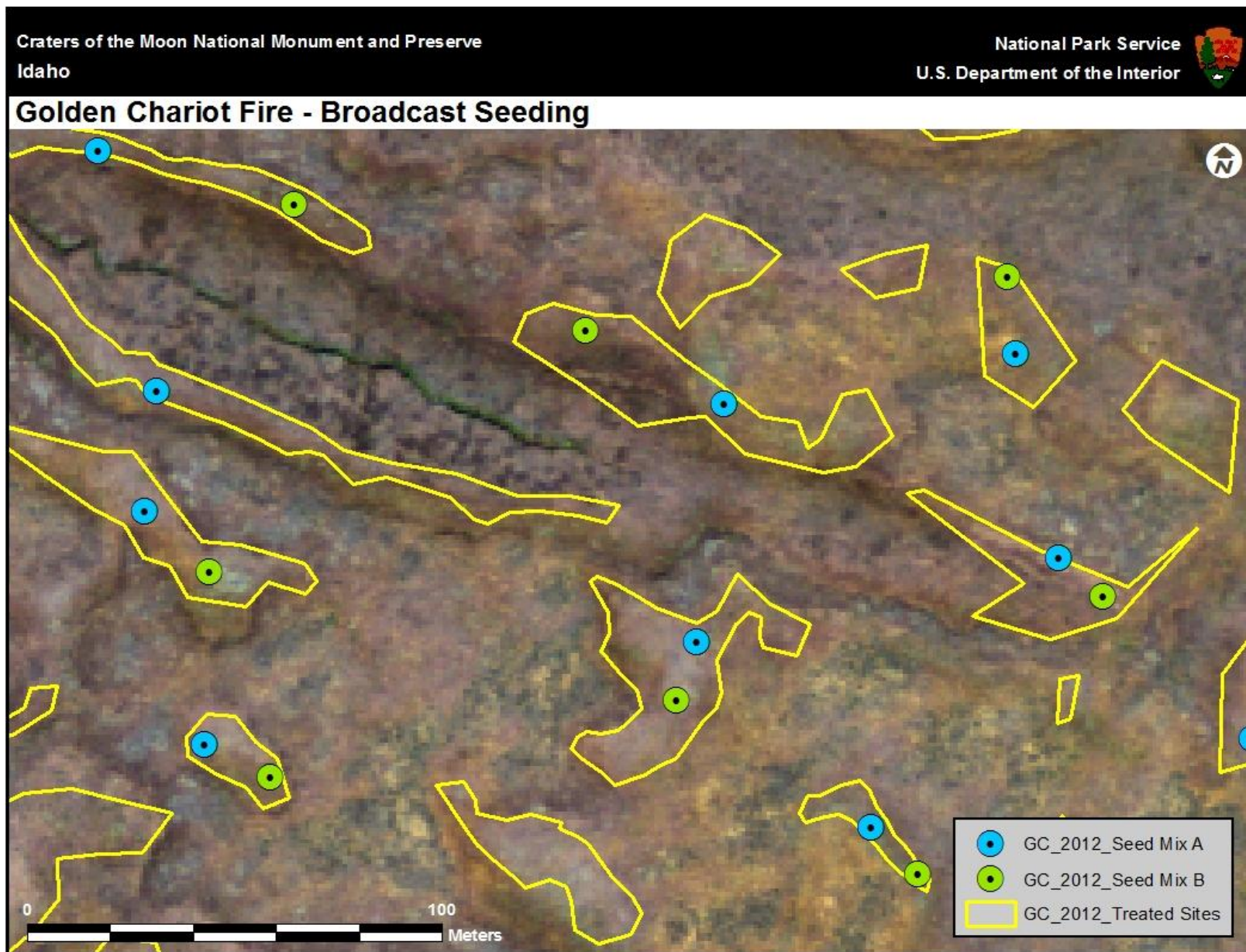


Figure 5. Example locations of broadcast seeding plots across the Golden Chariot Fire. Two mixes (A and B) were applied. Plots were selected with few persistent native plants and adequate soils. GPS coordinates were used to orient work crews.

Objective 4: Prescriptions for Future Fires

This objective is supported once we examine results from objectives 1 through 3. Lessons learned, both positive and negative, are discussed below as means to meet this objective (see the following section).

FIRST YEAR RESULTS AND DISCUSSION

Objective 1: Reduction of Fine Fuels

Qualitatively, herbicide treatments of the Golden Chariot Fire were incredibly effective at removing fine fuels in the interspaces among native plants (see series of figures below). No formal monitoring data was collected to get pre and post treatment cheatgrass cover measurements but the evidence is clear that fine fuels have been significantly reduced (i.e. consistently 95 to 100% effective where they were applied).

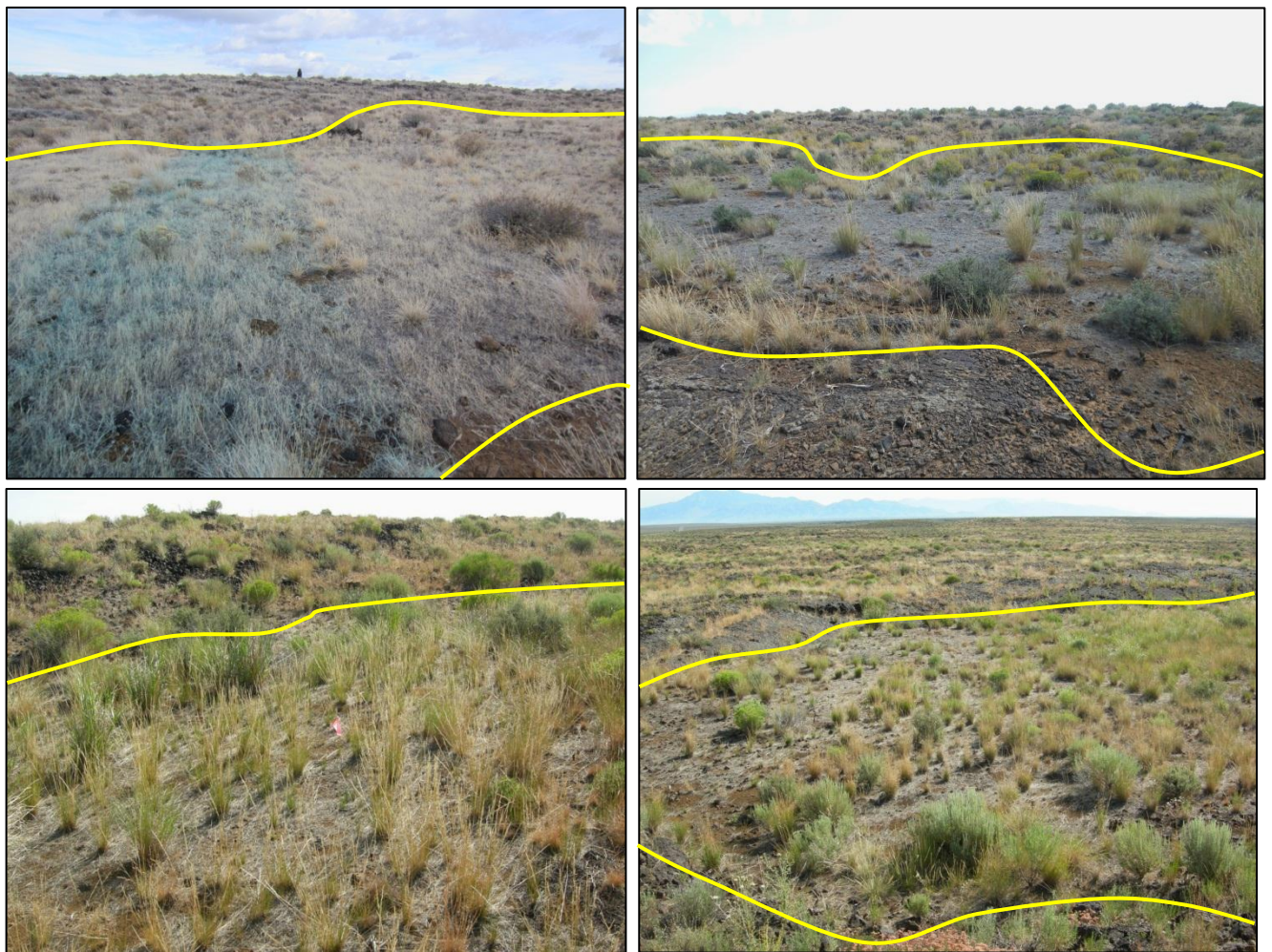


Figure 6. Top Left: Before photo of one treatment area of the Golden Chariot Fire (Oct 2012). Note the consistent herbicide coverage. **Remaining:** Three different areas eight months after herbicide and revegetation treatments (June 2013). Yellow lines define treatment areas. Note dead (gray) cheatgrass in the interspaces and successful seed production of residual native grasses.

Though also qualitative, it was very apparent looking at post treatment conditions that the two herbicide rates did not differ in their overall effectiveness. Not all cheatgrass germination was prevented in either case but these rare occasions were mostly restricted to beneath large shrub canopies. These areas were either missed during application or inadequately penetrated due to their large surface area. As for future prescriptions on the Golden Chariot Fire and other areas, low rates of herbicide appear to be doing very well and even slightly lower rates (4 oz / ac) might suffice under similar soil conditions, pretreatment cheatgrass cover, etc. CRMO expects to continue to pursue these lower rates as they continue to spot treat the Golden Chariot Fire now that these treatment areas are at a maintenance level.

Objective 2: Reestablishment of Native Species

Planting of bareroot mountain big sagebrush was overall a success. Timing of acquisition and planting could not have been more perfect (cool temperatures, enough staff to plant all plants within about 5 days, etc.). With a crew of eight, everyone had their individual method and style of planting. What seems to have been the most effective was using a sharpshooter shovel (long blade) to penetrate deep into the profile, wiggle the soil back and forth, and insert the bareroot plant behind the shovel blade. This method seemed to be the quickest while creating the least amount of soil disturbance. One challenge did surface in the spring, relocating plants. Separate of flagging every individual this appears to be a necessary evil with the planting of bareroot stock only 8 months old. Even still, looking at Table 2 below it appears we achieved similar first year survival as other local applicators of this bareroot planting method.



Figure 7. Successful fall-planted mountain big sagebrush plant (flowering).

Table 2. Mountain big sagebrush survival eight months after planting at the Golden Chariot Fire. Note one-third of the plants couldn't be relocated most of which likely did not survive.

Sagebrush Planted (10/2012)	Alive	Dead	Couldn't Relocate
1,348	494	409	445
Total First Year Survival (7/2013)	494 / 1,348 (36.6%)		

No photographs were taken of the broadcasting of native grass seeds unfortunately. Figure 8 shows seed cleaned and delivered by the NRCS in September of 2012. Plots were selected, seed mixes prepared, and plots were seeded for four days in early November following all other treatments. Plot size (5-m²) was chosen based on the amount of seed available, the desired seed density, timing available to conduct the application, and the plan for realistic assessments in the spring (i.e. smaller area to qualitatively look for establishment). Preseeding grass density was not measured prior to seeding; a potentially conflicting issue fully realized prior to the seeding treatment. The workload seemed too difficult (counting dormant grass plants that are hard to classify across 50 plots X 5m²). Instead, it was hoped that young seedlings would simply stand out from the unseeded areas next to them. Figure 9 shows the post treatment seed bed environment at a seeded plot.

Though the photo was taken in mid-July when young seedlings may already be dormant, seeded plots aren't showing early establishment, a discouraging result to say the least. Low spring precipitation, the amount of cheatgrass thatch on surface, and the potential for seed predation (ants and small rodents) are all significant and real factors of successful germination. Another growing season is necessary to be completely certain of these results.



Figure 8. Native grass seed ready for broadcast seeding of the Golden Chariot Fire.



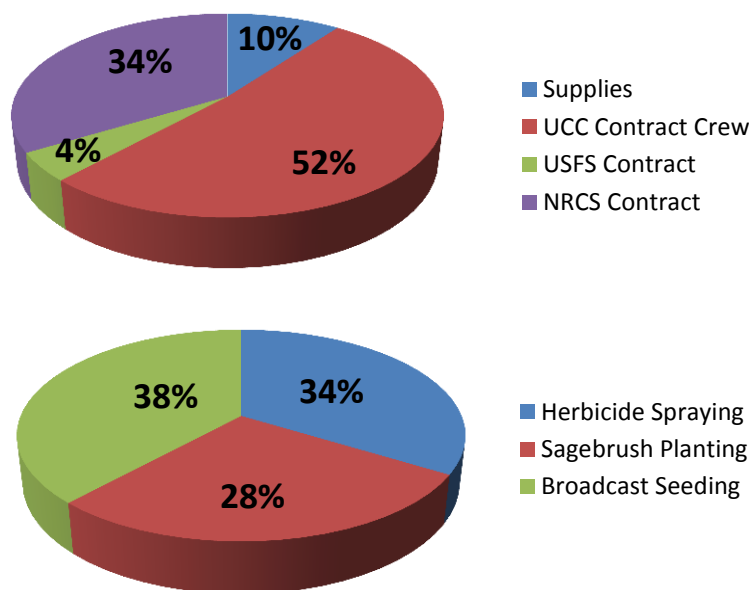
Figure 9. Post treatment seedbed of treatment areas of the Golden Chariot Fire.

This project has taught us several valuable lessons on small scale restoration efforts. When timed correctly, preemergent herbicides and small scale sagebrush planting can be incredibly effective in our area. Unfortunately, it also reiterated some common pitfalls; namely that broadcast seeding on the soil surface, no

matter how best envisioned, may not be an effective revegetation strategy. Frankly, the project's third and fourth objectives will continue to be pondered beyond the term of this project. Is the Golden Chariot Fire at a lower risk for a subsequent fire due to our efforts? This is tough to answer definitively. Fine fuels across the area have been greatly reduced and connectivity of fine fuels has been greatly diminished (see figure 9). With the fine fuels removed and native vegetation continuing to fill in the interspaces, I would say it is at or nearing a similar risk as the unburned vegetation surrounding it. Park staff will need to continue to spot treat and revegetate each treatment area now that most areas are on the right trajectory toward recovery. What did these treatments tell us about how to address future fires? It's clear that low rates of herbicide will have the desired effect but the reality may be that more broadscale methods are inevitable here for restoring CRMO lands after wildfire. Hand planting and backpack sprayers will just not be practical for fires only twice as large as the Golden Chariot Fire (say 300 acres or larger) and leaving these to recover on their own is no longer an option.

PROJECT BUDGET

Below are pie charts of project costs. The top chart identifies costs by personnel, supplies, etc. and the bottom shows costs by each restoration objective. Large supply costs were due to having to outfit an entire 8-person crew with the necessary gear and safety equipment. Just over 50% of project expenses were for staffing to complete the project objectives. The very affordable contract with Lucky Peak Nursery (essentially 80¢ per sagebrush plant) was counterweighted by the rather expensive NRCS seed cleaning contract (\$390/lb. of cleaned seed). Overall, costs for each objective were about the same. The sagebrush planting was far and above the most valuable expense given its success.



ACKNOWLEDGEMENTS

We thank the PWR fire and fuels program for providing funding for this opportunity and thank all agency cooperators / contractors for their competence and enthusiasm for this project.