

PLACE – BASED WEED MANAGEMENT AT CRATERS OF THE MOON NM&P: Goals, Objectives, and Current Tactics 2013

Hard to accept but the harsh reality of weed management today is not every weed can be controlled everywhere. Scarce resources have to be strategically allocated so that high priority areas and plants can be effectively addressed. Determining highest priorities is unique of course to the management area in question, the likelihood of success, and the resources available.

Here at Craters of the Moon National Monument and Preserve (CRMO) weed management began in the late 1990s, when the park unit was a fraction of its current size. Given its seemingly inhospitable conditions, management priorities then were simple; rely on 1-2 seasonal interns to annually hand remove weeds along all local roads, facilities, and trails. In 2000, CRMO expanded 13 fold to 750,000 acres requiring park staff to consider weeds on a much larger scale including BLM Monument lands. Further, in 2003, a small spike crew of the Northern Rocky Mountain Exotic Plant Management Team (EPMT) was established at the park. With a fortified crew of 2-4 seasonal staff including several weeks provided by a 3-person EPMT crew, management priorities continued to focus on roads of the expanded Monument and Preserve though more and more invasive plants were being discovered beyond these facilities. In 2007, an NPS/BLM Monument Management Plan was completed in part to provide some general direction as to what interagency weed management actions would be pursued. Using this plan as a foundation, park staff continued to prioritize aggressive treatment of at least all noxious weeds encountered and look for opportunities to address other nonnatives like cheatgrass.

In 2011, CRMO helped develop the Northern Rockies Invasive Plant Management Plan (IPMP) to comply with NEPA requirements and help better define park priorities. The plan goes into great detail as to how nonnative plants are identified, prioritized, and addressed at ten mostly small national park units including CRMO. CRMO is, however, a large park that is uniquely co-managed with the BLM. As such, different weed priorities and control strategies have now emerged for different areas of the Monument and Preserve. Essentially, different strategies arose because of differences in resources at risk, the weeds that are currently present, an area's past treatment history, its varying topography and isolation, and the number and type of land designations of each area. Going forward, in addition to how priorities are defined in the IPMP, it has become clear that weed management at CRMO is best served further separated into manageable units where prioritization and treatment criteria can then be applied.

Before defining management units and prioritizing weeds and actions, we first reassert several decision-making tools from the IPMP. Applying Step 1 (page 120), understand that as of 2008 100 plants (about 1 out of every 7) found within CRMO's boundaries are nonnative. Many of these plants are uncommon and nonthreatening and some have even been purposefully planted on BLM lands as good competitors after wildfire. However, let it be known that the "invasiveness" of several of this introduced species is not fully understood (e.g. forage kochia, crested wheatgrass, etc.). These uncommon and planted nonnative plants (about 75 of the 100)

are not being actively managed by CRMO at this time. Most of the remaining 25 plants are considered invasive, i.e. they actively spread into new areas displacing native plants. Applying Step 2 of the IPMP decision tool (page 121), CRMO managers currently limit the scope of our weed management efforts to these 25 plants as they pose the most risk and are considered the highest threat to ecosystems across all areas of the Monument and Preserve. Currently 15 of these 25 plants are on the Idaho state noxious weed list. Noxious weeds are those nonnative plants that significantly modify the landscape and state law requires land owners to control them to the greatest degree practicable.

The following report attempts to clearly define management units and work objectives that will help guide future actions and planning and document annual shifts in workload. Of course, all unit sections should be revisited routinely to ensure tactics haven't changed given new information or changes in sensitive resources of a particular area. Currently, 6 management units have been identified; a seventh management unit that is formed by a combination of several others is also discussed. For each unit, an overall weed management goal is described. Objectives are then listed in no particular order that apply to that area and current tactics are quickly summarized. Work days (number of crew members X number of days) are also totaled by objective to provide a general estimate of annual effort. Several workday estimates were tweaked slightly to round these numbers to the nearest day/person.

For each unit, a quick table is also presented that ranks invasive weeds that are currently known to occur or be imminent. These rankings were obtained using the Alien Plant Ranking System (APRS, version 5.1, Windows XP) as was done in preparation of the 2011 Northern Rockies Invasive Plant MP. This software is a computer-implemented system to help land managers make difficult decisions concerning invasive, nonnative plants. The system relies on a set of 23 questions to be answered for each nonnative plant known to occur in an area of concern. The questions are summarized into three criteria: the current level (significance) of a weed's impact to the area or site, the potential of the species to be a pest (invasive), and the feasibility of weed control measures. For this report, we summarize the first two criteria as a means to highlight which weeds are top priorities based on their inherent invasiveness and threat to CRMO's native communities, irrespective of how feasible it may be to control them.

Several other important distinctions need to be made clear for this report. The term "eradication" is defined as a weed management strategy where all known plants are aggressively and permanently removed and efforts are continued until the seed bank is exhausted. In contrast, "containment" is a strategy where a buffer zone around an infested area is maintained free of invasive plants in the interest of keeping the surrounding landscape weed free and "suppression" is a strategy where maybe not every plant is removed but the effects on infested areas are reduced (see IPMP, page 133). To date, CRMO rarely "contains" or "suppresses" invasive plants. There are a few exceptions (both areas and weeds) but typically all known plants are removed using all available treatment methods.

Also, in the unit descriptions below often strategic distinctions are made between perennial, biennial, and annual plants. This is commonly due to the dominance of cheatgrass and other invasive annual grasses throughout most areas of the Monument and Preserve. CRMO is currently unable to address these grasses at such a broad scale in most management units.

Summary of Management Units and Objectives:

Below are the 19 management objectives across 7 main management units that are discussed in detail in the following report. Objectives have been prioritized according to a scoring rubric in Appendix 1. Four people scored each work objective based on a where the project occurs, what weeds are being addressed, the likelihood of project success, whether prior treatments have been effective, what are the local resources at risk, and the timing when the project needs to occur.

Management Unit	Objective	Priority
Wapi Lava Field	Eradicate Dyers Woad	high
VC, Housing, Loop Road, and Parking	Eradicate Weeds on Park Trails	high
VC, Housing, Loop Road, and Parking	Eradicate Weeds around Park Facilities	high
North End	Eradicate Canada Thistle	high
Internal Lava Fields	Survey / Eradicate Weeds from "Park Special" Kipukas	high
Internal Lava Fields	Survey / Eradicate Weeds from Other High Priority Kipukas	high
North End	Survey and Eradicate Weeds from Highway / Spur Roads	high
CRMO Wilderness / CRMO Lava – East	Survey and Eradicate Weeds from Buttes and Cinder Cones	medium
North End	Mechanically Eradicate Weeds in Big Cottonwood	medium
Carey Lava Field / CRMO Lava – West	Eradicate Leafy Spurge from the boundaries of CRMO	medium
CRMO Wilderness / CRMO Lava – East	Survey and Eradicate Weeds from Wildfire Areas	medium
BLM Monument Lands	Suppress Noxious Weeds from the Little Park Fire	medium
VC, Housing, Loop Road, and Parking	Suppress Cheatgrass around Park Facilities	medium
North End	Suppress Highway Sweet Clover	low
Wapi Lava Field	Eradicate Other Noxious Weeds in Wapi Kipukas	low
North End	Eradicate Biennials in Little Cottonwood / Leech Creeks	low
BLM Monument Lands	Survey and Eradicate Weeds from Monument Roads	low
BLM Monument Lands	Survey / Eradicate Weeds from Eastern Monument lands	low
Wapi Lava Field	Detect and Eradicate New Invaders	low

Visitor Center, Housing, Loop Road, Trails, and Parking Areas

Goal: *Eradicate all invasive perennial and biennial plants and suppress all invasive annual plants across all visitor use areas.*

This management unit is defined by the weed management challenges created by park visitors and infrastructure. Objectives are centered on when and where disturbance occurs, because these areas are often where new invaders are discovered, and because keeping this unit free of invasive plants protects the larger landscape experienced by most park visitors.

- Objectives:**
- 1) *At least twice from mid-July through early August, survey, map, and mechanically treat biennial and perennial weeds around the visitor center, loop road and all loop spurs, campground, park housing, and parking areas.*
 - 2) *Hike Broken Top, Tree Molds, Devils Orchard, Inferno Cone, Caves, North Crater, and the first two miles of the Wilderness trail in mid to late July to survey, map, and mechanically treat any biennial and perennial weeds.*
 - 3) *Mechanically treat cheatgrass patches in early June around the visitor center, parking islands, select trails, and housing areas.*

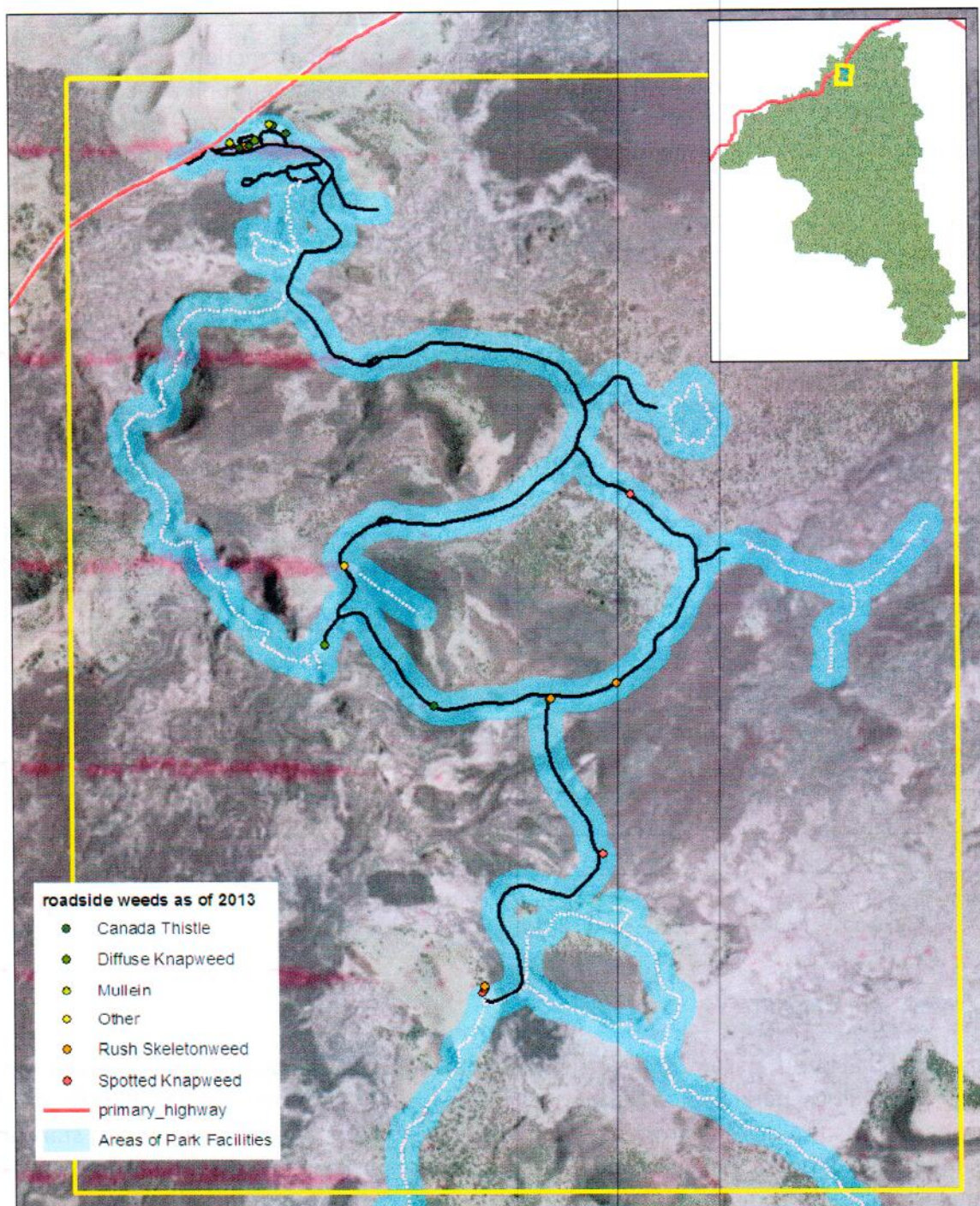


Figure 1. Visitor Center, Housing, Loop Road, Trails, and Parking Areas.

Current Management Tactics:

This management unit is frequently disturbed by visitors, park construction, etc. Various nonnative and previously unknown invasive plants in this management unit are common. In addition to those in the table below, penny cress, tumble mustard, Russian thistle, kochia, prickly lettuce, lambs quarters, and sweet clover among others may invade and, though fleeting, these should be removed as they appear. Because there are only a dozen plant locations or fewer in these areas per year and they can be easily revisited, plants found should be exclusively removed by hand and shovel. Isolated plants near or just past the flowering stage with a single taproot in well-drained soils are very effectively removed by hand. Below is the current prioritization of weeds known to have occurred around park facilities. Cheatgrass is not listed and discussed separately below in objective 3.

Plant Name	Significance of Impact	Ability to be a Pest	Totals
Canada thistle (<i>C. arvense</i>) – N	60	86	146
rush skeletonweed (<i>C. juncea</i>) – N	60	68	128
knapweeds (<i>C. diffusa</i> and <i>stoebe</i>) – N	35	71	106
crested wheatgrass (<i>A. cristatum</i>)	36	49	85
buffalobur (<i>S. rostratum</i>) – N	33	40	73
puncturevine (<i>T. terrestris</i>) * – N	15	49	64
common mullein (<i>V. thapsus</i>)	24	40	64
smooth brome (<i>B. inermis</i>)	16	48	64
bulbous bluegrass (<i>P. bulbosa</i>)	22	41	63
dandelion (<i>T. officinale</i>)	16	46	62

N = state listed noxious weeds

* = seed heads found around visitor center in 2010

Objective 1: Park Facilities

Pursuant to objective 1, park staff have always opportunistically surveyed and removed invasive weeds from facilities, parking areas, and roads throughout the summer. Admittedly though, it is occasionally unclear as to which weeds require treatment. Using the table above as a starting point, multiple surveys of facilities should occur each season to ensure essentially no weeds become established. Below are the workdays spent in 2013 to address this objective:

Total workdays (2013)	# of people	# of days	Total
	4	1	4

Objective 2: Park Trails

To date no systematic survey of all park trails has ever been performed as it has always been thought that most lava field trails were impenetrable to weeds. However, noxious weeds are being found in the harshest environments and, pursuant to objective 2, an annual survey of all trails will start in 2014; mid to late June would be the best time frame. At this time, no chemical treatments will be used due to lack of sizable infestations and logistical challenges of getting water to more remote areas. As seen below no workdays were spent in 2013 to address this objective:

Total workdays (2013)	# of people	# of days	Total
	-	-	-

Objective 3: Cheatgrass Around Facilities

Pursuant to objective 3, since 2006, park staff has annually hand pulled cheatgrass from parking islands and around the visitor center and housing areas for 1-3 days in early June. This activity often occurs with the assistance of all park staff as an end to seasonal training week. The main reasons for this effort are to prevent further cheatgrass expansion and to showcase an area visitors routinely experience that is free of invasive grasses.

Starting in 2011, the Devils Orchard Trail has also been annually hand weeded of small and mostly isolated patches of cheatgrass along the edge of the eastern parts of the trail. These patches appear anecdotally to be the only invaded areas surrounding Devils Orchard.

The only herbicide treatments performed in this management unit are during the fall. In late October, herbicides have been applied on larger cheatgrass patches around the visitor center, housing areas, and any areas where it has invaded from recent disturbance (i.e. past construction, etc.). From 2009 to 2011, park staff sprayed cheatgrass and saw reductions that surprisingly lasted several seasons beyond treatment. Below are the workdays spent in 2013 to address this objective:

Total workdays (2013)	# of people	# of days	Total
	3	2	6

Craters of the Moon Wilderness Area / Craters of the Moon Lava Field - East

Goal: *Eradicate all invasive perennial and biennial plants throughout all areas.*

This management unit is defined by its critical resources (i.e. high value kipukas, pika, sage grouse, limber pine, and wilderness values) and how it is mostly weed free and generally more inhospitable to weed invasion. Work objectives are centered on discovering and maintaining the most intact, weed free areas.

- Objectives:**
- 1) *In mid to late July, hike Coyote Butte, Sheep Trail Butte, The Watchman, The Sentinel, Split Butte, Fissure Butte, and Two-Point Butte to survey, map, and mechanically treat rush skeletonweed and any other biennial and perennial weeds.*
 - 2) *In mid to late July, adequately survey and treat burned areas of the management unit to ensure they remain free of all invasive noxious weeds.*

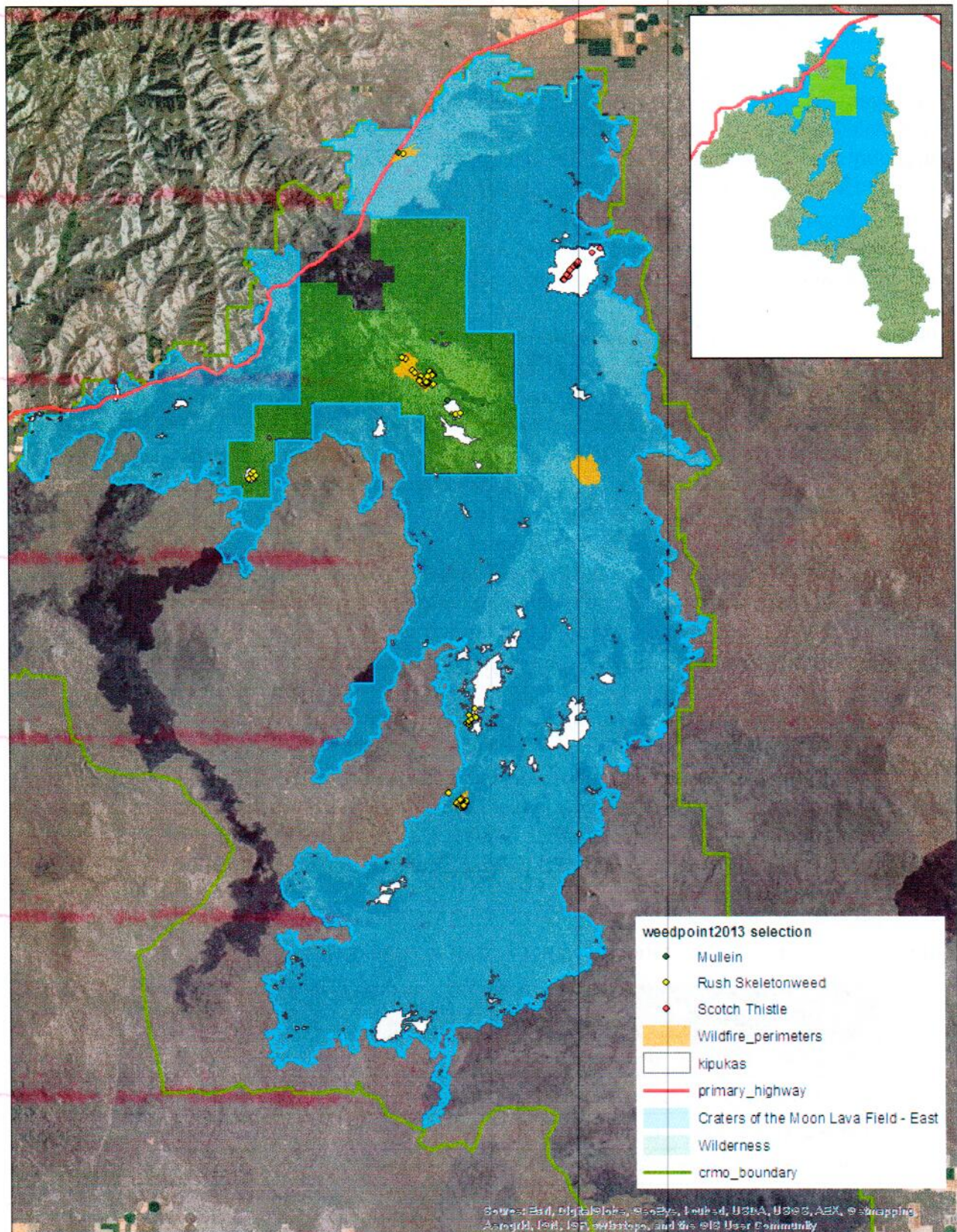


Figure 2. Craters of the Moon Wilderness / Craters of the Moon Lava Field – East.

Current Management Tactics:

Far and above all others, rush skeletonweed presents the most serious weed threat to this management unit. Large infestations of this weed on BLM lands south of the Carey Lava Field (the Wild Horse Desert) have been rapidly spreading unmanaged to the east and south, probably since the early 2000s. Hopeful that southern Paddelford Flat and west central portions of the BLM Monument could be spared, park staff aggressively treated satellite populations of rush skeletonweed on horseback and foot in these areas from 2006 to 2008. It was quickly realized that without greater resources and a comprehensive interagency effort, the weed could not be eradicated from, or even contained to, these large areas.

Biological control agents have been noted on a larger number of rush skeletonweed infestations around CRMO, particularly where infestations are dense. Impacts from a gall mite (*Eriophyes chondrillae*) in the form of poorly formed seed heads) and less from a rust fungus (*Puccinia chondrillina*) as spots on stems have been frequently observed, though it is unclear when and where these agents were first and then subsequently introduced. It is obvious they are decreasing seed production and reducing overall plant vigor but they don't appear to be slowing establishment or spread of the plant. In 2010, one other biocontrol agent (*Bradyrrhoa gilveolella*) was tested by the USFS Rocky Mountain Research Station at two sites, one south of Paddelford and one south of the Carey Flow, through a research permit. It was hypothesized that the root-feeding moth may prefer sandy soils along the southwestern edges of CRMO. Unfortunately, this one year pilot project had limited success as only one adult moth survived beyond the study period. However, establishment of this biocontrol has been difficult across the state and one surviving adult is better than none. Further pursuits may be warranted. The report can be found at R:\Resource Info\Vegetation\Weeds\Reports\Biocontrol Efforts.

In the meantime, park managers feel resources are likely better spent discovering weed-free areas internal to the lava fields, namely in high valued kipukas while looking for opportunities to pursue other large scale control methods. As such, a number of pursuits are taken each season to discover and protect areas of this management unit from all noxious weeds but rush skeletonweed in particular.

Below is the current prioritization of weeds known to have occurred:

Plant Name	Significance of Impact	Ability to Be a Pest	Totals
rush skeletonweed (<i>C. juncea</i>) - N	62	68	130
Scotch thistle (<i>O. acanthium</i>) - N	27	56	83
crested wheatgrass (<i>A. cristatum</i>)	25	49	74
smooth brome (<i>B. inermis</i>)	18	51	69
common mullein (<i>V. thapsus</i>)	25	40	65
bulbous bluegrass (<i>P. bulbosa</i>)	16	40	56

N = state listed noxious weed

Objective 1: Buttes and Cinder Cones

Pursuant to objective 1, after hearing early season reports in 2013 of large infestations of rush skeletonweed across south facing portions of The Sentinel and a number of other buttes, staff took a longer look at these areas in early and mid-summer. While several areas were false reports, park staff did map 25 new rush skeletonweed infestations (averaging 4-5 plants) mainly in the area disturbed by the 2000 Echo Crater Fire. These plants were mechanically removed and sites will need to be revisited as hand removal of skeletonweed is highly variable. Other noxious weeds and mullein need to also be addressed in these areas to meet objective 2. Crews spent the amount of effort below on this objective in 2013, a very reasonable annual investment to keep these areas noxious weed free.

Total workdays (2013)	# of people	# of days	Total
	4	2.5	10

Objective 2: Wildfire Areas

Four wildfires have burned in this management unit since 2000 and are listed below and shown on the unit map (page 9). Essentially these are the significant wildfires that have occurred on NPS acreage for the last 30 years. Several other small areas (Coyote Butte and others) have also partially burned in the recent past and these small lightning fires have gone essentially unrecorded.

All of these NPS wildfires have been left to recover unassisted with one exception. Fire rehabilitation funding was sought and approved in 2013 (and will again be requested in 2014) to address weed invasion created by the 2012 Lava Tube Fire. This was requested as part of a larger investigation into fire recovery on vegetated lava fields. The 2000 Golden Chariot Fire (same preburn vegetation type as the Lava Tube Fire) was heavily invaded by cheatgrass 4-5 years after the fire and park staff are concerned the Lava Tube Fire may suffer the same fate. Predisturbance vegetation estimates obtained from plots read during the 2008 vegetation mapping effort was intact mountain big sagebrush with 1-5% cheatgrass. Though more aggressive sagebrush seeding and pre-emergent aerial herbicide treatments were seriously considered for the fall of 2012, these treatments were dropped based on low likelihood of seedling establishment and high application expense. In 2013, areas were found recovering; however, cheatgrass was more ubiquitous than expected. It appears the rockier terrain of the burn (at least half of the area) had cheatgrass seed "in wait" as these areas were quickly

Fire	Year	Acreage
Echo Crater	2000	631
Golden Chariot	2000	166
Purple	2006	179
Lava Tube	2012	520

enough to outcompete invading cheatgrass? The next five years will be critical and to achieve objective 3 and additional funding is being requested for continued surveys and any noxious weed treatments (though none are present so far).

Except the kipuka area of the Purple Fire that has been aggressively invaded by rush skeletonweed and has essentially been sacrificed, most of these other wildfire areas are noxious weed free. However, in 2013 a number of rush skeletonweed infestations were mapped and treated in the Echo Crater Fire and several sites were found on the Golden Chariot Fire ten years after it burned. It may be that these areas are more vulnerable to weed invasion (Golden Chariot near a major highway and Echo Crater upwind and on higher ground of weed sites in nearby Laidlaw Park). Pursuant to objective 2, these burned areas need to be annually surveyed and mechanically and chemically treated to keep them noxious weed free providing at least the same or more effort as in 2013 below.

Total workdays (2013)	# of people	# of days	Total
	4	4	16

North End (including two-tracks, spur roads, and the HWY 20/26/93 corridor)

Goal: *Eradicate all invasive perennial and biennial plants throughout all road and highway corridors and mountain drainages while protecting ground water resources and being sensitive to the needs of private land owners and cooperators.*

This management unit is primarily defined by Highway 20/26/93 and various two-track spur roads where weeds routinely reinvade and new invaders are often discovered. Park staff has put a great amount of investment on these roads since the late 1990s to protect this unit's unique, higher elevation habitats.

- Objectives:**
- 1) *Twice survey on foot (late June and mid-August) and chemically treat the entire highway corridor from mile marker 213 to 240 and all spur roads north of the highway (save the Big Cottonwood main drainage) to eradicate knapweed, rush skeletonweed, and Canada thistle and eradicate new invaders.*
 - 2) *In mid to late September, apply herbicides to spot treat isolated Canada thistle patches throughout northern riparian drainages and larger highway patches using environmentally sensitive products where necessary.*
 - 3) *Survey and treat larger infestations of yellow sweet clover along the highway in late June to early July.*
 - 4) *When and where feasible, remove by hand invasive biennial plants common mullein, bull thistle, and burdock throughout Little Cottonwood and Leech Creek drainages in late July to protect unique vegetation communities and the park's groundwater.*
 - 5) *Collaborate with private land owners annually to mechanically remove noxious weeds on roads throughout the Big Cottonwood drainage.*

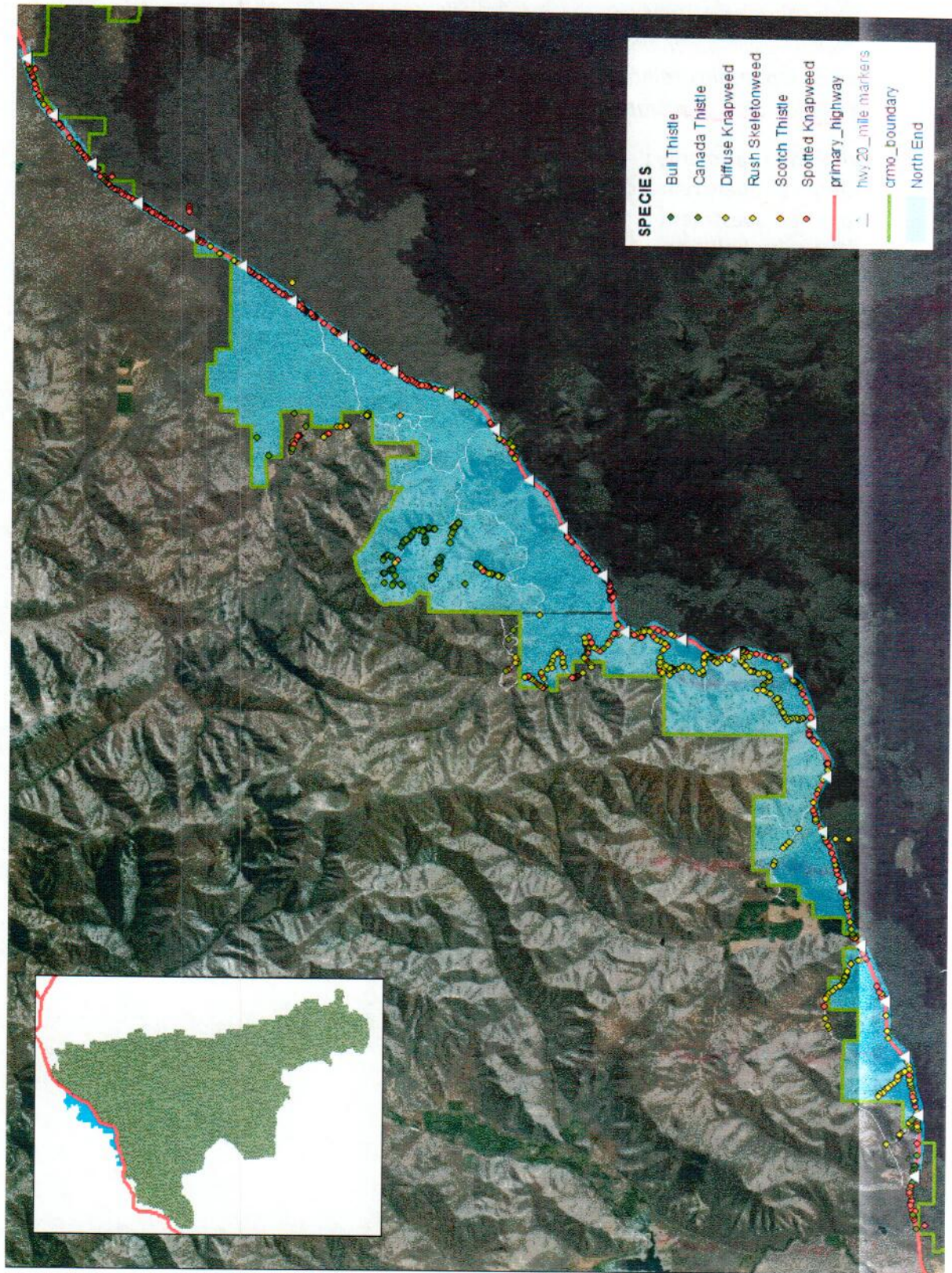


Figure 3. North End (including two tracks, spur roads, and the HWY 20/26/93 corridor.

Current Management Tactics:

Below is the current prioritization of weeds for this management unit, though plants typically encountered are spotted and diffuse knapweed, Canada thistle, rush skeletonweed, and mullein. Rare infestations of leafy spurge, Dalmatian toadflax, field bindweed, houndstongue, and black henbane have also been detected early and treated in this unit. As a general rule, CRMO staff does not treat private lands for invasive plants unless contact has been made and a comprehensive approach is in place.

Plant Name	Significance of Impact	Ability to be a Pest	Totals
rush skeletonweed (<i>C. juncea</i>) - N	75	68	143
leafy spurge (<i>E. esula</i>) – N	49	84	133
Canada thistle (<i>C. arvense</i>) – N	42	86	128
knapweeds (<i>C. diffusa</i> and <i>stoebe</i>) – N	40	71	111
burdock (<i>A. minus</i>)	44	54	98
field bindweed (<i>C. arvensis</i>) - N	29	65	94
Dalmatian toadflax (<i>L. dalmatica</i>) - N	38	54	92
Scotch thistle (<i>O. acanthium</i>) - N	25	59	84
bull thistle (<i>C. vulgare</i>) – N	25	57	82
houndstongue (<i>C. officinale</i>) - N	18	52	70
common mullein (<i>V. thapsus</i>)	24	40	64
sweetclover (<i>M. officinalis</i>)	9	51	60
black henbane (<i>H. niger</i>) – N	13	40	53

Objective 1: Highway and Northern Spur Roads

Knapweeds have long been an issue along the highway and spur roads in northern CRMO. While counties annually treated these areas, they treat them once a season and often miss infestations beyond the immediate right-of-way. To address this concern, CRMO first received funding to treat all northern road segments in 2003 using Student Conservation Association (SCA) interns via funding through the Public Land Corp Program. Additional funding was obtained in 2006, 2008, and 2010 via Natural Resource Cyclic Maintenance funding (PMIS #109928). Twice surveying all roads throughout the summer on foot for eight straight years, infestations have been greatly reduced. These treatments have been so timely and effective that in 2010 it was decided that that site-by-site treatment was no longer necessary along the highway. For the last four seasons (2010 to 2013), knapweeds, rush skeletonweed, Canada thistle, and any other noxious weeds are now treated and tallied by highway mile sections using a 65-foot buffer from the highway centerline. Spur road sites, sites falling outside this buffer, and highway polygons (larger infestations) are still surveyed and treated independently. Permanent eradication of knapweeds, rush skeletonweed, and Canada thistle is not realistic as highway traffic will continue to introduce seeds of these invasive plants. In particular, trucks

Bringing hay west to south western Idaho stock yards are common and hay bales are occasionally lost in transit. Regardless, pursuant to objective 1, surveys and treatments should continue to eradicate these noxious weeds along all northern road segments to protect the greater landscape. New invaders (namely leafy spurge, Dalmatian toadflax, and houndstongue) should also be eradicated.

Finally, one single workday is performed at the "Brody Property", a privately owned ranch about 3 miles up Blizzard Mountain Road just north of CRMO boundaries, with the Lost River Cooperative Weed Management Area (CWMA). Brody was the name of the previous owner; the current owner is unknown at this time. This spray day has been conducted annually since 2008 and its purpose is to eradicate noxious weeds, knapweed primarily, from the ranch property to the northeast of the CRMO boundary.

A great number of workdays were performed on this objective in 2013:

Total workdays (2013)	# of people	# of days	Total
	4	7.5	30

Objective 2: Canada Thistle

Canada thistle has been treated at CRMO since 2003; however, a successful and big picture treatment strategy for this plant is still being refined. Historically, park staff would conduct several work days in early August to chemically spray thistle patches prior to seed set. Other local area land managers have had great success in recent years chemically treating Canada thistle in the early fall after seed set when plants are putting resources to their roots. The general consensus is that Canada thistle spreads and expands more from its root system than from seedling establishment. While a difficult change to accept (allowing plants to go to seed), park staff started waiting to treat all of our patches in mid-September starting in 2011. Unfortunately, several years into this strategy and it appears many sites are not declining as expected. Another variable has been the use of Habitat herbicide on sites that are near the water's edge which changes year to year. A number of sites indicate this herbicide may not be as effective as Milestone. Several test plots were established in 2013 to try and determine which fall herbicide treatment is most effective. Half of several patches near Leech Creek were treated with Milestone and half treated with Habitat. If resources allow, another strategy with persistent sites may be to "dead head" plants (removing and bagging seed heads by hand) in early August with a follow up fall spray treatment in mid-September.

In 2013, park staff also began treating sites beyond the northern Monument boundary in an attempt to curb invasion by isolated patches to the northwest of CRMO. These herbicide applications need to be choreographed with local land owners as there are several and Lava Lake still maintains an organic band of sheep that periodically graze the main Big Cottonwood drainage. Herbicides would compromise their organic status but the current understanding is that if they are isolated and we inform them, we may be able to treat them. If thistle patches are ever to be addressed in the main Big Cottonwood drainage, Lava Lake LLC would need to be convinced that they are a significant threat to their entire operation.

To achieve objective 2, park staff should continue to discover an effective treatment strategy and apply it to eradicate thistle from the park and eradicate other patches proximate to CRMO that have the potential to invade. Below is the number of workdays performed in 2013:

Total workdays (2013)	# of people	# of days	Total
	4	2.75	11

Objective 3: Sweet Clover

Beginning in 2010, park staff began treating biennial sweet clover along the highway mainly from mile markers 226 to 232 due to fears that, at least anecdotally, it seemed to be expanding. Several herbicides have been used though Escort plus 2,4-D seems to be the most effective if treatment occurs 7-10 days prior to seed set. Garlon was used by the Northern Rockies EPMT in 2012 and was incredibly effective for immediate control (effects seen in 2 days) though this product may be too "hot" for repeat applications. Beyond these mile markers, it appears generally too hot and dry to support clover; several isolated plants have been noted but not treated. Admittedly, this invasive weed seems to be fleeting, heavy in places one year and totally absent the next following treatment. It does reoccur sporadically in areas where it isn't treated. It is doubtful that any single year weed treatment has been 90-100% effective and it is unclear why this occurs. To meet objective 3, limited workdays should be utilized if available to treat larger patches with herbicides to reduce overall competitive pressure to the surrounding landscape. Late June is often the most ideal time. As seen below, very little time was spent in 2013 to address this objective though drought conditions may have limited its 2013 establishment.

Total workdays (2013)	# of people	# of days	Total
	4	0.5	2

Objective 4: Biennials in Little Cottonwood and Leech Creeks

Since 2003, park staff has tried to eradicate bull thistle and mullein on the north end of the Monument along Little Cottonwood and Leech Creeks. Because these areas are sources for the park's groundwater, these plants are mechanically treated in late July as both plants typically flower the same time of year. These weed infestations are not added to the park's GIS weed geodatabase unless the infestation is large and isolated.

Admittedly, there has been some debate as to how these two biennials should be treated. Ground disturbance may create safe sites for reinvasion. If treatment is timed right rosettes can be ignored and flowering stalks of adult plants can be cut (and bagged if necessary) to prevent seed dispersal thereby avoiding any physical disturbance of the soil. Tough to do in practice because timing has to be just right to prevent reflowering, most plants were completely dug up in 2013. Pursuant to objective 4, park staff should continue to suppress both weeds in all mountain drainages of the north end to keep populations as low as possible.

In 2010, aggressive attempts were made to mechanically and chemically (using Habitat) treat burdock throughout lower portions of Leech Creek and Little Cottonwood Creek. With so many infestations throughout both drainages that are often difficult to access, it was felt that this approach was impractical and burdock has not been systematically addressed since that year. Fortunately burdock has an affinity for shaded riparian areas and it is generally restricted to the wettest areas of these creeks.

Below are 2013 time commitments for this objective:

Total workdays (2013)	# of people	# of days	Total
	2	2.5	5

Objective 5: Big Cottonwood

To achieve objective 5, the roads along Big Cottonwood are mechanically treated for weeds with assistance from Lava Lake LLC, one of the adjoining private land owners and operators of an organic sheep operation. An unwritten agreement between parties starting in 2008 was to collaborate for a single work day in early July. Contact is made with the ranch in mid-June to set the date. Typically Lava Lake ranch provides 2-3 sheep herders/laborers to walk and pull weeds from the main road segments; park staff routinely addresses the more remote spur roads and drainages. Park staff also takes a few additional hours another day to mechanically treat these areas in early August. A formal cooperative agreement is needed that allows NPS resources to be spent beyond northern Monument lands that adjoin Lava Lake Ranch properties. The following table shows the limited workdays spent on this objective in 2013:

Total workdays (2013)	# of people	# of days	Total
	4	0.75	3

Wapi Lava Field (southern Great Rift WSA)

Goal: *Ensure kipukas remain free of all invasive noxious weeds and biennial weeds.*

This management unit has been heavily altered on its periphery by agriculture to the east and wildfire to the west, north and south, and internally by aggressive weed invasion, mostly cheatgrass and tumble mustard. However, park staff and BLM have put a great amount of investment in eradicating dyers woad since 2008. Work objectives are centered on treating then maintaining weed free areas.

- Objectives:**
- 1) *Conduct a minimum of three visits per year to as many infested sites as possible to aggressively survey and chemically treat dyers woad to eradicate this plant from CRMO.*
 - 2) *Survey and treat all rush skeletonweed, scotch thistle, knapweeds, and two mullein species in and immediately surrounding kipukas where patches are significantly isolated and can be followed up with annual investment.*
 - 3) *In mid-June, survey agricultural field edges and roads for new invaders such as medusahead and star thistle west of the Wapi Lava Field to prevent invasion into CRMO.*

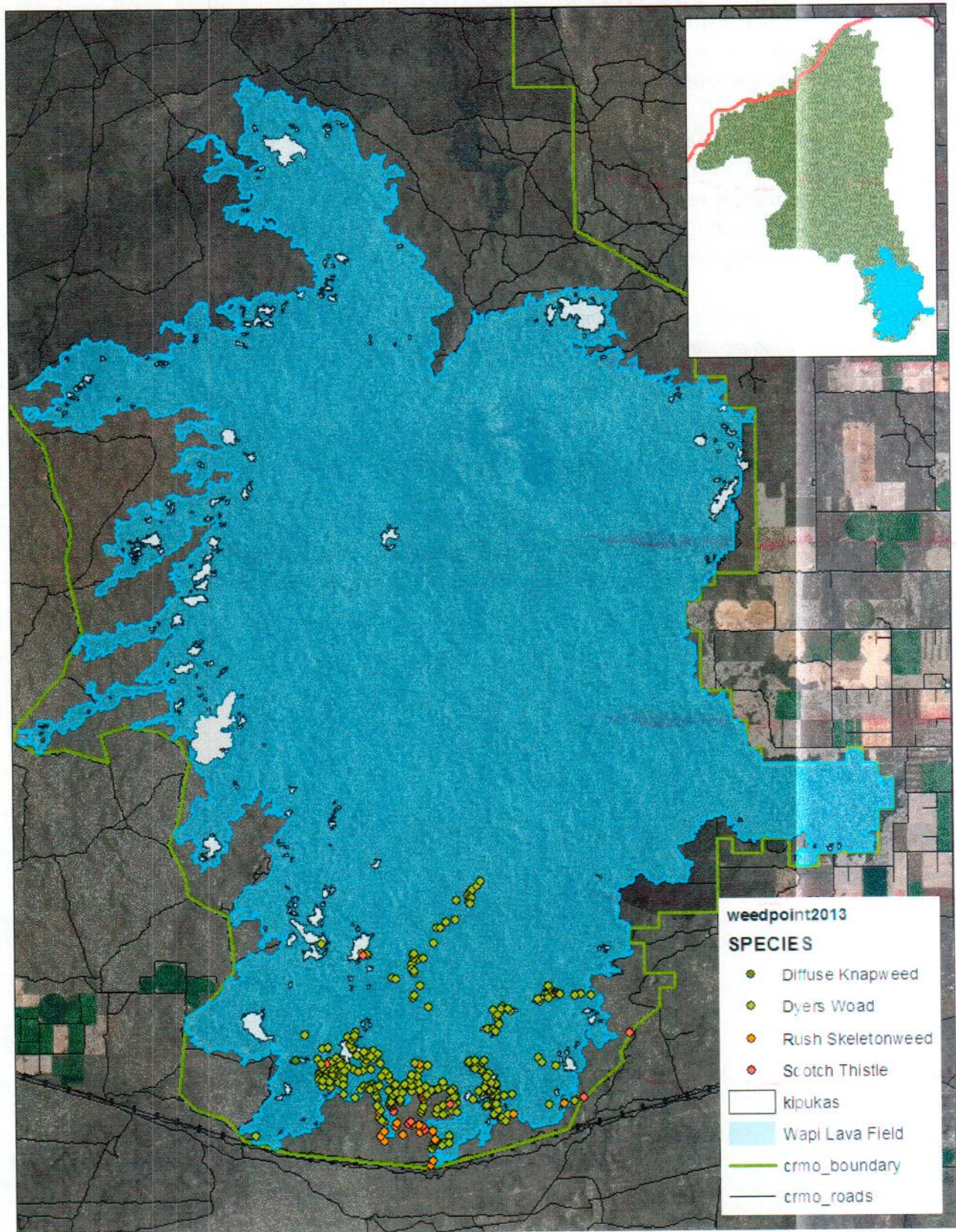


Figure 4. Wapi Lava Field (southern Great Rift WSA).

Current Management Tactics:

Quite frankly, CRMO does not have the resources to control all invasive plants, or even just noxious weeds, along the edges of the Wapi Lava Field. These areas have been heavily altered by livestock grazing, agriculture, repeat wildfires, and weed invasion. Making it more difficult, most high priority areas are a great distance from park facilities (2 hour min). It actually wasn't until 2007 that any weed management efforts were made in this area.

However, several aggressive weed management efforts are now being conducted and below is the current prioritization of noxious and biennial weeds known to have occurred in and around this management unit. Let it be known, however, that no systematic survey of areas surrounding the Wapi Lava Field beyond well-traveled access roads has ever been performed.

Plant Name	Significance of Impact	Ability to be a Pest	Totals
dyers woad (<i>I. tinctoria</i>) - N	56	59	114
rush skeletonweed (<i>C. juncea</i>) - N	45	68	113
diffuse knapweed (<i>C. diffusa</i>) - N	24	71	95
Scotch thistle (<i>O. acanthium</i>) - N	27	48	75
moth mullein (<i>V. blattaria</i>)	27	38	65
common mullein (<i>V. thapsus</i>)	24	40	64

N = state listed noxious weed

Objective 1: Dyers Woad

Since it was discovered in 2007, dyers woad has been aggressively surveyed and treated along the southern third of the lava field annually from early May through mid-June. Park staff, occasionally joined by the Northern Rockies Exotic Plant Management Team (EPMT), visit as many known patches as possible, as many times as possible using 5-6 seasonal water caches delivered by horseback. Every year since 2008, water cache delivery has been funded by the Blaine County Cooperative Weed Management Area (CWMA). However, state funds are in decline and it is uncertain whether the CWMA will continue to fund the project.

The first site visit is often the first full week of May to confirm water availability, size up infestations, and make early treatments; this trip could be the first to be sacrificed if resources are limited. The park has alternated between applying the herbicides Telar and Escort, both often accompanied by 2,4-D. Typically Escort or Telar is applied alone early in the season prior to bolting. There has been a great deal of variability in terms of plant impact but Escort appears to show the most consistent herbicide effects. All of these herbicides require 7-10 days for impacts to appear so timing of return visits is crucial. Critical also is that once seeds begin to form, seed stalks must be ripped off as woad has the ability to set viable seed within a week following any herbicide application. Plants with well-developed green to black seeds must be double bagged and removed off site. Fall treatment of rosettes has also been conducted since

2010 using Telar and 2,4-D. There isn't a great deal of research or evidence how effective these treatments are or have been and late fall return trips have not been done to confirm herbicide control. In 2013, 2,4-D alone was used in the fall as research indicates it is ideal for the rosette stage.

The east side of the Wapi is seasonally difficult to access. The only two-track road is not maintained and can only be accessed early in the summer. Road conditions and lack of adequate field time prevent crews from addressing eastern areas of the Wapi in the fall.

Shoshone BLM assists by conducting a one-day aerial survey and remote treatment effort by helicopter in late May. Following the sixth year of treatment, complete eradication is a distant endpoint but much ground is being made with most infestations reduced by 40-50%. However, getting these patches to lower percentages will be challenging and new infestations are now common among the lava field interior. Contract crews with Minidoka County also occasionally spray weeds along CRMO's southern boundary but they target woad and thistle by ATV only.

Pursuant to objective 1, park staff must continue to be equally aggressive and survey and treat all plants. As indicated below, this is the most work investment of any single objective for CRMO; it's more than double the amount of the second largest work investment (highway and spur roads at 38 hours).

	# of people	# of days	Total
Total workdays (2013)	5	17	85

Objective 2: Other Noxious Weeds in Kipukas

During aggressive attempts to eradicate dyers woad, a common question arises as rush skeletonweed, and to a lesser degree Scotch thistle, is rapidly invading southern areas of the Wapi (particularly in the south central part). Why isn't CRMO being as aggressive with these weeds as they are with dyers woad? There are a couple of reasons. First and foremost, few dyers woad infestations are known from anywhere near the boundaries of CRMO making local eradication very possible. Second, dyers woad appears to have a particular affinity for the sparsely vegetated rocky terrain of the Wapi and a number of kipukas have already been invaded. Third, controlling these other species beyond kipukas would mean much greater manpower, additional site visits, and more chemical combinations to make survey and treatments efficient. Fortunately, besides woad, noxious weeds are rarely found in Wapi kipukas and this objective could be met with targeted diligence. Thus, to meet objective 4b, park staff should opportunistically survey Wapi kipukas for rush skeletonweed, Scotch thistle, and any new invaders and treat these to continue to keep kipukas noxious weed free. It is obvious from looking below at the workdays spent in 2013 this objective can be met with a couple extra days spent down on the Wapi.

Total workdays spent (2013)	# of people	# of days	Total
	4	2	8

Objective 3: New Invaders

For objective 3, GIS weed layers from Burley BLM in 2009 showed a couple new invaders within 5 miles of CRMO's southwestern boundary. Medusahead and starthistle could be devastating to the Monument's native plant communities. Though Burley BLM has indicated they have addressed these sites, there is little confidence they have been completely eradicated. To date, three medusahead patches have not been visited because of other work priorities and because they are through a large tract of private agriculture east of the Carey Kimama Road. These and any other new infestations need to be a greater priority going forward. No workdays were invested in this objective in 2013.

Total workdays spent (2013)	# of people	# of days	Total
	-	-	-

Carey Lava Field (Raven's Eye WSA) and Craters of the Moon Lava Field - West

Goal: *Ensure kipukas remain free of all invasive noxious weeds and biennial weeds.*

Like the Wapi Lava Field, this 68,000-acre management unit has been heavily altered on the periphery by agriculture to the west and wildfire to the south and internally by aggressive weed invasion, mostly cheatgrass and rush skeletonweed. However, park staff has put a great amount of investment in eradicating leafy spurge since 2002.

Objectives: 1) *Conduct a minimum of two visits per year to as many infested sites as possible to aggressively survey and chemically treat leafy spurge to help BLM contain this plant to areas south and west of CRMO.*

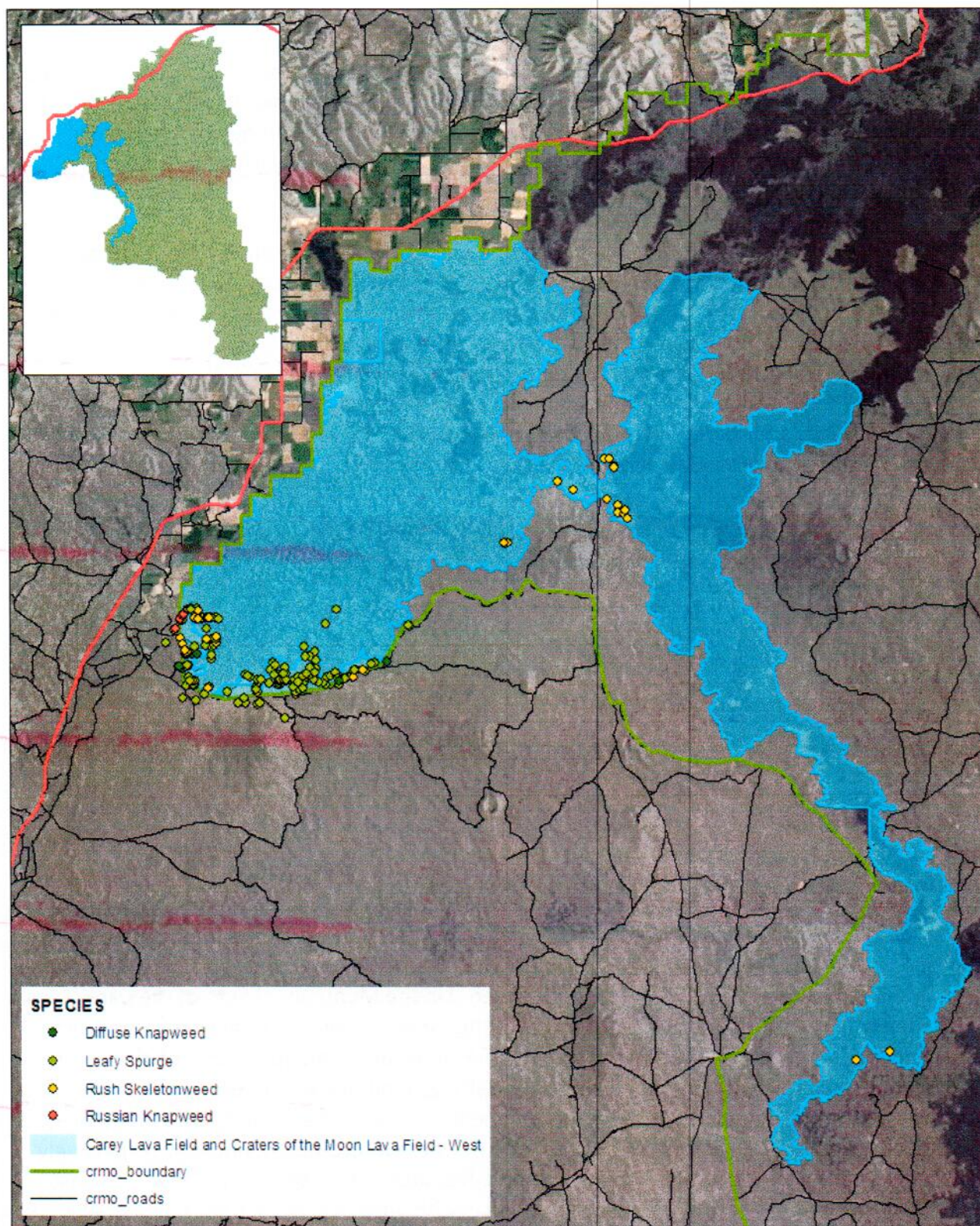


Figure 5. Carey Lava Field (Raven's Eye WSA) and Craters of the Moon Lava Field – West.

Current Management Tactics:

Similar to the Wapi Lava Field, CRMO does not have the resources to control all invasive plants, or even just noxious weeds, along the edges of the Carey Lava Field, particularly areas to the southeast near Wagon Butte where diffuse knapweed and rush skeletonweed are rapidly expanding uninhibited. These areas have also been heavily altered by livestock grazing, agriculture, and weed invasion.

Below is the current prioritization of noxious and biennial weeds known to have occurred in and around this management unit. Fortunately, thistles and knapweeds are relatively rare in the management unit with the exception of areas near the Little Wood River corridor to the west and BLM roads immediately south. However, this management unit is particularly vulnerable to new invaders like Mediterranean sage, toadflax, etc. as they have been documented nearby. Rush skeletonweed is also rapidly expanding north and east into the lava fields themselves and there isn't much that can be done to slow its progress. Also, no systematic survey of areas surrounding the Carey Lava Field has ever been conducted.

Plant Name	Significance of Impact	Ability to be a Pest	Totals
leafy spurge (<i>E. esula</i>) - N	75	81	156
rush skeletonweed (<i>C. juncea</i>) - N	64	75	139
Russian knapweed (<i>Acroptilon repens</i>) - N	51	73	124
diffuse knapweed (<i>C. diffusa</i>) - N	27	56	83
Scotch thistle (<i>O. acanthium</i>) - N	13	46	59
common mullein (<i>V. thapsus</i>)	15	29	44

N = state listed noxious weed

Objective 1: Leafy Spurge

Leafy spurge has invaded over 25,000 acres of the Wild Horse Desert southwest of CRMO. The Shoshone BLM has been treating this region of their district for over 30 years. It is unclear when spurge first became established but sites discovered in the Monument south of the Carey Lava Field make up the north and northeast edges of this large infestation. Today, an interagency treatment strategy involves the establishment of a large containment line around the entire perimeter, spot chemical treatments on the periphery, about a dozen releases of biological controls within the containment area, and routine helicopter surveys along Little Wood River and the Carey Lava Field across the western and northern infestation boundaries respectively. NPS crews have agreed to only chemically treat infestations north of the road that runs east-west just south of the Carey Flow to avoid conflicts with biological release sites. Essentially, NPS crews work in the Monument north of the road running from Preacher Bridge to the Carey Kimama Road. The BLM however does land and spot treat spurge sites they encounter during their helicopter survey efforts.

To date, close to 130 spurge sites found in and around the southern Carey Lava Field are currently maintained in the CRMO weed geodatabase. No plants were found at 73 of these sites when they were surveyed in 2013. Further, no plants have been found at 38 sites for at least 3 years. However, an average of 3-4 new sites have been discovered each year since 2011 and many of these have been quite large (over 500 plants).

The Northern Rockies EPMT was instrumental from 2004 to 2007 to get most areas surveyed, mapped, and treated. These efforts did, however, create some logistical challenges causing CRMO to systematically remove sites from the park weed geodatabase*. All spurge sites are visited and chemically sprayed in the early summer with Tordon, currently CRMO's only restricted use pesticide herbicide. Sites need to be thoroughly surveyed and treated to a diameter of 30 meters surrounding each GPS point. Starting in 2010, spurge sites on NPS lands are also visited in the fall (mid-Sept) and sprayed with Plateau, an herbicide not currently approved for BLM lands. In recent years, when time constraints existed, sites that had been dead for at least 3 years where not visited. In the fall, any sites obtained by BLM's aerial helicopter survey the previous June are also a high priority for visit and treatment. The weed geodatabase is updated only on the first visit. An exception is if no plants are found in the summer (site was "dead") but plants are found in the fall. In these events, the number of fall plants, cover, and etc. are assigned leaving the summer visit date.

Total workdays spent (2013)	# of people	# of days	Total
	7	3	21

* Standard EPMT practice is to survey and remap weed locations by GPS every year for reporting purposes. As a result, 2-4 spurge GPS points were created for what CRMO considered a single weed location. In 2009, upon creation of the CRMO weed geodatabase, "EPMT_080706_Background" was created to house all EPMT sites that couldn't be determined to be an existing CRMO site without field verification. Sites closer than 5 meters to CRMO spurge sites were removed to simplify resurvey and treatment efforts. Further ground truthing and setting new survey standards for spurge in 2012 allowed staff to permanently delete the EPMT layer from the geodatabase.

BLM Monument Lands

Goal: *Control noxious weeds on select BLM Monument areas.*

This management unit is defined by lands administered by our interagency partner, the Bureau of Land Management. Most weed management efforts made by the BLM relate to limited treatments following wildfire, range facilities (improvements), and road maintenance. Expecting them not to cover all roads and all high priority areas in perpetuity, our work objectives focus on treatment areas they cannot continue or pursue. Keeping noxious weeds suppressed in this unit will slow weed spread and protect the larger volcanic landscape.

- Objectives:**
- 1) *Chemically suppress rush skeletonweed throughout the 2009 Little Park Fire using aggressive grid searches for 2-6 days per year.*
 - 2) *When feasible, chemically treat knapweeds along all spur roads of Laidlaw Park, Paddelford Flat, and Little Park particularly near areas of good biotic integrity.*
 - 3) *When and where feasible, survey portions of the east side of the Monument to ensure that roadside noxious weeds are suppressed.*

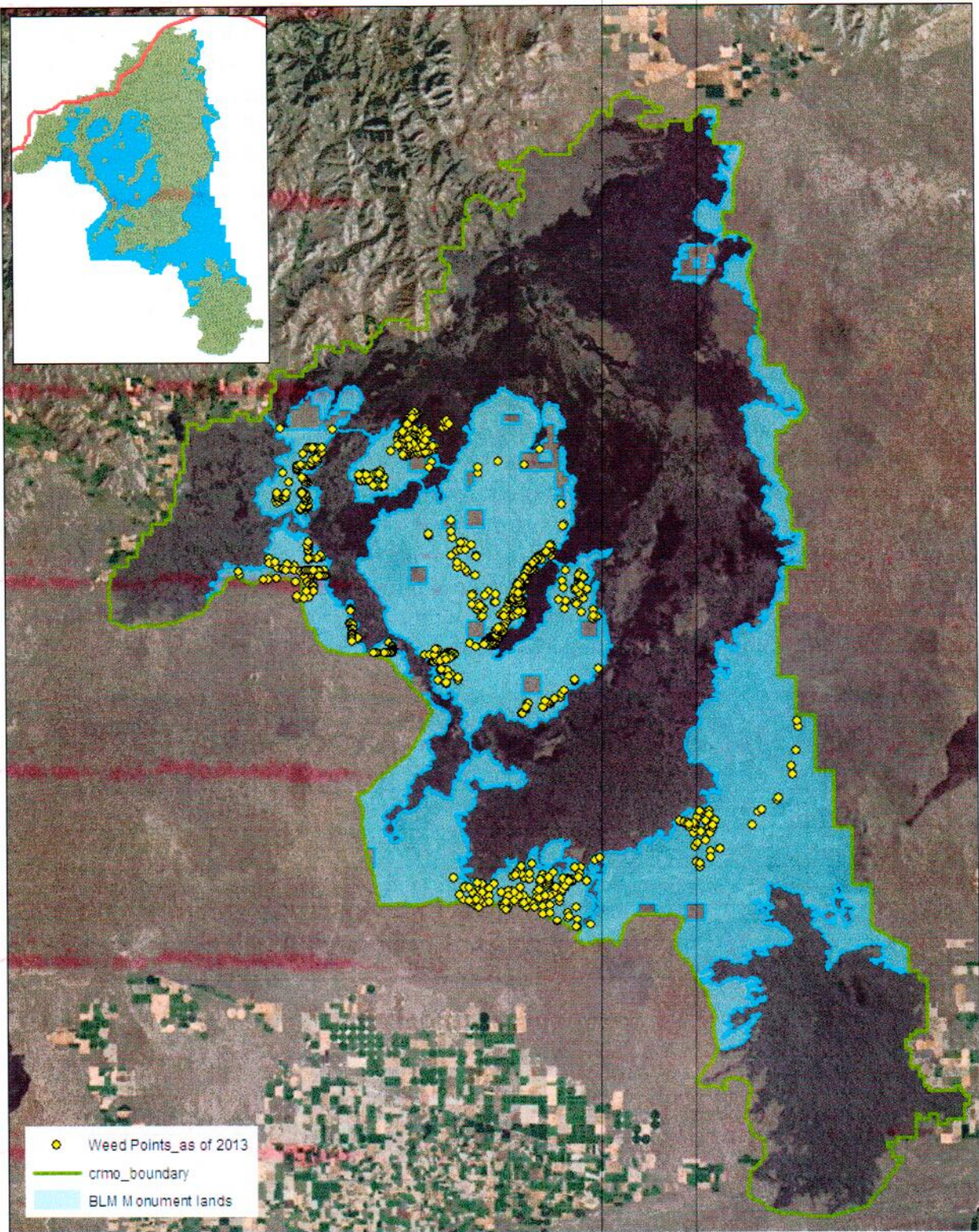


Figure 6. Select BLM Monument Lands of Craters of the Moon NM&P.

Current Management Tactics:

Similar to other areas, CRMO does not have the resources to control noxious weeds across 260,000 acres of BLM Monument lands, particularly when weeds such as rush skeletonweed are spreading so rapidly across the region. Further, many of these areas have been disturbed by livestock grazing, recreational use, and frequent wildfires leading to further weed invasion. Looking at the map and reality is that “ignorance is bliss” as many areas of this management unit have never systematically surveyed. Given what has been discovered where significant effort has been made, the map drastically underestimates the weed challenges across BLM Monument lands.

Nevertheless, areas identified in the 2006 Monument Management Plan as having “good biotic integrity” might be a place to focus weed prevention and suppression efforts in this management unit. Northeastern sections of Little Park and northern areas of Laidlaw Park are large areas identified as having the best biotic integrity on BLM Monument lands. This may be because they are some of the wettest and highest in elevation. As indicated on the previous map, a few select areas of this management unit have been systematically surveyed and treated for noxious weeds over the last 10 years. Most of these efforts however have stayed on major roadways. One exception would be surveys conducted in 2006 and 2007 by NPS crews to address rush skeletonweed invasion in Paddelford Flat and immediately south (see western weed locations in Figure 6). Unfortunately, other than rehabilitation efforts 2-3 years after wildfire, BLM tactics for weed management throughout this unit are largely unclear. Below is the current prioritization of weeds found in and around this management unit:

Plant Name	Significance of Impact	Ability to be a Pest	Totals
rush skeletonweed (<i>C. juncea</i>) - N	75	68	143
leafy spurge (<i>E. esula</i>) – N	49	84	133
Canada thistle (<i>C. arvense</i>) – N	42	86	128
knapweeds (<i>C. diffusa</i> and <i>stoebe</i>) – N	40	71	111
Russian knapweed (<i>A. repens</i>) – N	44	54	98
field bindweed (<i>C. arvensis</i>) - N	29	65	94
Scotch thistle (<i>O. acanthium</i>) - N	25	59	84
bull thistle (<i>C. vulgare</i>) – N	25	57	82
Mediterranean sage (<i>S. aethiopsis</i>) - N	18	52	70
common mullein (<i>V. thapsus</i>)	24	40	64

Objective 1: Little Park Fire

In September of 2008, a human caused fire burned 1,792 acres of near-pristine sagebrush in the northeast corner of Little Park. Figure 7 shows the area and the number of new weed locations by year since 2009. Approximately 435 acres of the burned area (essentially the southwestern quarter) was ground seeded with both native and introduced species by the BLM.

There is also a 5-acre enclosure along the western edge (blue box in figure below), half of it seeded and half of it unseeded for comparison; however, it is not known how well these seeded plants have established.

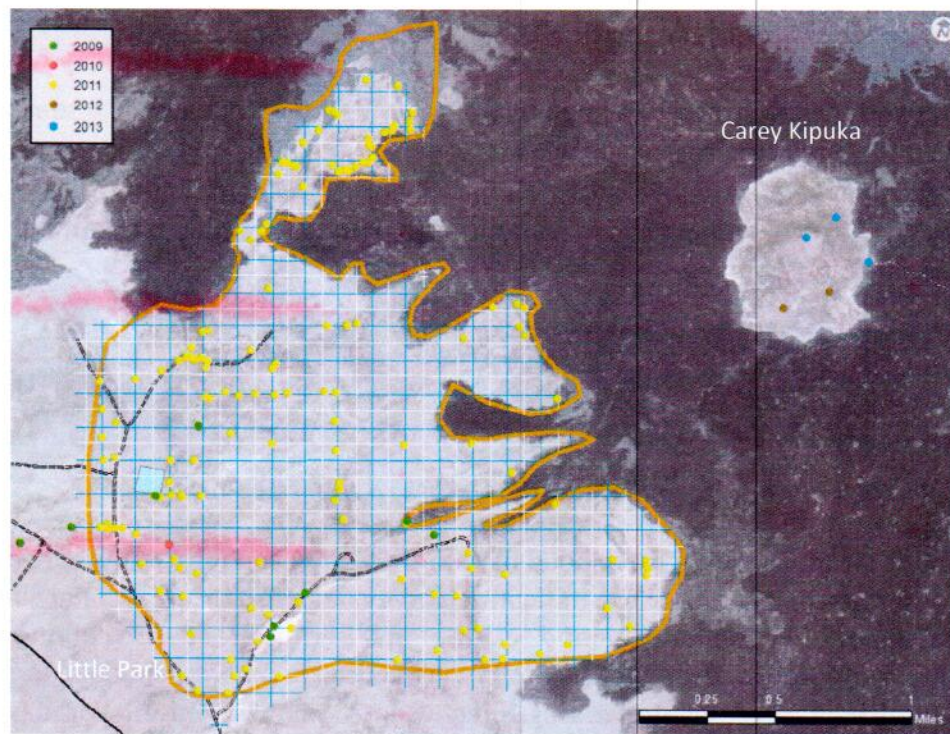


Figure 7. Weed locations to date for the 2008 Little Park Fire and Carey Kipuka.

NPS crews began systematically surveying the entire Little Park Fire in 2009 using 100 meter grid separation. Every other year the grid is offset by 50 meters to provide tighter overall ground coverage. Full eradication of all noxious weeds by mechanical means was the objective to help aid the recovery of native and seeded vegetation in Little Park and to protect surrounding areas, namely Carey Kipuka to the immediate east (see map above).

Anecdotal evidence suggests that the area continues to improve. For 2009 and 2010, there was extensive nonnative tumble mustard and prickly lettuce, particularly along roads, but that has since declined. Few noxious weeds (less than a dozen sites) were discovered and treated mechanically during these first two years. Unfortunately in 2011, rush skeletonweed was found scattered throughout the burn and our mapped sites went from 11 to 158 with most sites ranging between 1 and 10 plants. A few knapweed and one Canada thistle site has been discovered and a large infestation of mullein was found in 2013 in the northern section of the burn. Not enough resources are available to eradicate mullein from this area.

In 2013, we changed our weed management strategy for the Little Park Fire*. Rather than realistically eradicating all weeds, we have decided to suppress rush skeletonweed for a set

* Another option to survey and treat a smaller area of the burn (say the eastern lava edges) was considered in 2012 but this option was determined unrealistic given that rush skeletonweed dispersal distance is so large making the protection of smaller area meaningless.

time frame while eradicating all others. It would take weeks of work to locate all rush plants using available resources. Instead, no new sites are mapped as it has become too difficult for large work crews to cover the area using GPS units while conducting an efficient search. In 2013, sites were also chemically treated (w/ Milestone) as it became doubtful that mechanical removal was completely eradicating each weed location.

It is hoped that with a new strategy defined by a set number of work days each season that weeds will be sufficiently suppressed allowing native plants to progressively outcompete the scattered weeds that remain. Below is the number of workdays spent on this objective in 2013. Based on previous years' experience, a maximum of 20 workdays should be spent on Little Park weed suppression efforts.

Total workdays spent (2013)	# of people	# of days	Total
	6	3	18

Objective 2: Roads in Paddelford Flat, Laidlaw Park, and Little Park

Monument roads into these areas have been haphazardly surveyed for noxious weeds since 2003. As for other areas, it is simply too difficult to survey large expanses of mainly intact sagebrush grasslands of Paddelford Flat and Laidlaw Park. Because roads are common vectors for new and recurring weeds, they continue to be highlighted in our weed management program. No work days were devoted to this objective in 2013 but at least 3 workdays should be tallied in 2014 covering as many road segments as possible in mid to late June.

Total workdays spent (2013)	# of people	# of days	Total
	-	-	-

Objective 3: Eastside of the Monument and Preserve

The Arco-Minidoka Road receives some of the least weed management oversight of any area in the Monument and Preserve. At this time, the only systematic weed management of this area is performed by the Lost River Cooperative Weed Management Area. Their staff of 3-4 annually treats knapweed infestations along the Butte County boundary, mainly by ATV. No work days were devoted to this objective in 2013.

Total workdays spent (2013)	# of people	# of days	Total
	-	-	-

Internal Lava Fields

Goal: *Survey and treat all high priority kipukas to ensure they remain noxious weed free.*

This supplemental management unit is defined by lands internal to all three major lava fields of Craters of the Moon National Monument and Preserve. Kipukas are one of the Monuments most fundamental resources and they require survey and weed protection to the greatest degree practicable irrespective of management unit.

- Objectives:**
- 1) *Systematically survey and treat kipukas that park staff has defined as "special". Park special kipukas are those with specific designation (research natural areas, natural national landmarks, etc.) or those that simply have been uniquely defined and/or carefully researched.*
 - 2) *Systematically survey and treat all other "high priority" kipukas throughout the Monument.*

Current Management Tactics:

There are over 600 kipukas within the Monument that range from less than an acre to over several thousand acres. For about the past five years, there has been growing concern that many kipukas, even those that are extremely isolated, are being threatened by noxious weed invasion. This is particularly true for weed threats like rush skeletonweed that are long distance seed dispersers. Starting in 2010, park staff began haphazardly surveying high interest kipukas for rush skeletonweed and other noxious weeds. The focus has been Carey Kipuka, North Laidlaw Butte, Brass Cap Kipuka, and Little Prairie. Noxious weed sites were discovered in several of these kipukas and a few other areas the park long felt were essentially immune to invasion, namely the 2000 Echo Crater Fire. It has since been realized that a strategic plan is needed to ensure the weed management program is robust yet pragmatic enough to protect at least the Monument's top ecological priorities.

A kipuka prioritization effort has been developed to rank kipukas based on criteria park staff felt were most important in determining a kipuka's ecological importance. The four criteria are a kipuka's existing vegetation characteristics, it's degree of isolation, it's potential for resilience from disturbance, and the ability of park staff to effectively survey the kipuka with a high degree of confidence. Existing vegetation characteristics were estimated using the 2009 vegetation map and photos from any previous survey efforts. A strong factor for this rating was the degree of cheatgrass presence. Generally kipukas harboring a rather unique vegetation type and appearing relatively uninvaded received the highest marks (3), while common, more disturbed kipukas received the lowest score (1). Degree of isolation, on a scale of 1-5 is how separated a kipuka is from any known disturbance be it the edge of the lava field, a highway, railroad track, or any other potential weed vector. Isolated kipukas are expected to be more resistant to weed invasion and these were given the highest marks. Every kipuka's potential for resilience (ability to recover to preexisting conditions following a disturbance like wildfire) was also examined using two climatic geospatial datasets (raster files). First, a digital elevation

model (10 meter resolution) was applied, clipped by the lava flow boundary layer, to provide five equally spaced elevation bands across the Monument. The higher the elevation, the higher the rating (1-5) with the logic that higher elevation kipukas are predicted to receive cooler temperatures and possibly more precipitation leading to shortened native plant recovery times. To further identify wetter kipukas, we also examined 30-year averages of PRISM model data at 800 meter resolution. PRISM climate models are essentially projections of predicted precipitation based on triangulated averages of local weather station data. This data is publicly available at <http://www.prism.oregonstate.edu/> - 3/18/2014). With the assistance of the I&M Network GIS specialist, this 800m resolution layer was also clipped to the lava flow boundary and the precipitation range was separated into five bands (5 being the wettest, 1 being the driest). Below are the individual layers in Figures 8 and 9. Scores of each rating (elevation and PRISM) were summed by kipuka with the highest "environment score" being 10 and the lowest at 2. Finally, the capacity of current staffing, etc. to survey a kipuka was rated on a 1-3 scale. This is important because a number of these areas are quite large and require a considerable amount of effort to get to and completely survey. No kipuka with a score lower than nine was i

The highest possible score for the prioritization exercise was 21 and the lowest was 5. At this stage, no minimum score was required to be on the list. Two kipukas scored 20 (Round Knoll and another other nearby). No kipuka attaining a score of less than 9 was included. Currently 90 kipukas (around 15%) were included in the prioritization exercise as it was felt that any more than 100 would be too difficult to survey on any systematic basis. No lower elevation, lower precipitation kipukas mainly along the western and southwestern edges of the Monument made this list. However, future reviews of this prioritization may consider including several more kipukas, possibly areas of the northwest Wapi and Carey Lava Fields and more from east of Laidlaw Thumb. At this time no evidence exists that would indicate that any of these and other kipukas have any unique and intact vegetation resources. In fact, a great number of these west and southwest kipukas are considerably infested by cheatgrass and other nonnative plants.

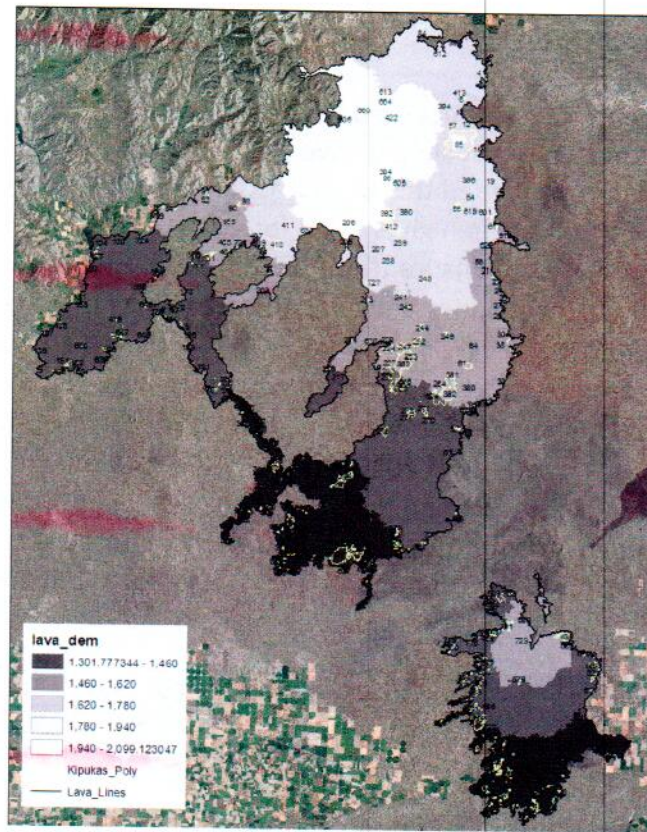


Figure 8. Digital elevation model (DEM) split into five bands for Craters of the Moon NM&P.

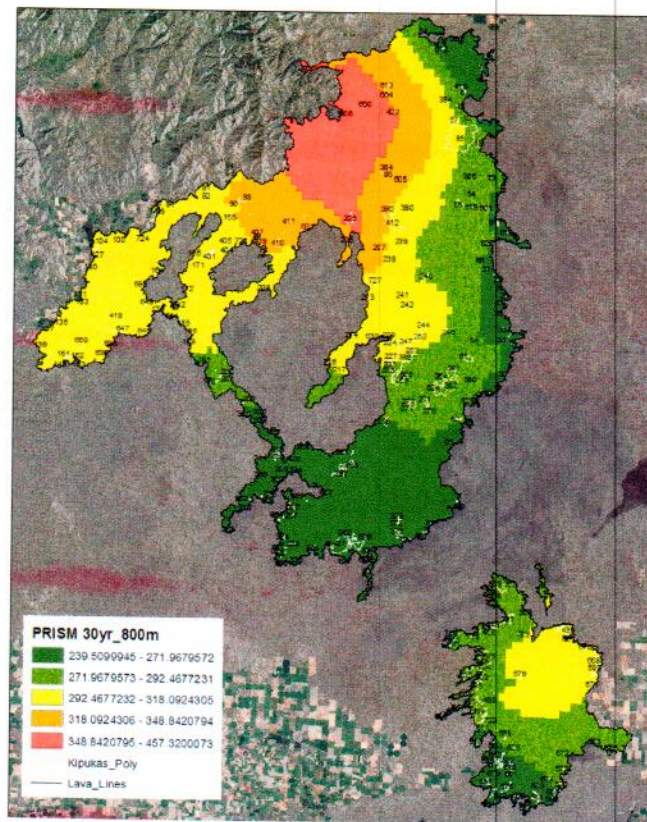


Figure 9. PRISM model split into five precipitation bands for Craters of the Moon NM&P.

Objective 1: "Park Special" Kipukas

"Park special" kipukas are those with specific designation (research natural areas, natural national landmarks, etc.) or those that simply have been uniquely defined and/or carefully researched. A couple of kipukas needed this special attention because the kipuka prioritization effort (Appendix 2) doesn't rank them high enough for strategic survey and protection. Quite frankly this category was created to ensure these seemingly low priority kipukas (namely Sand Kipuka and its associated RNA) get addressed in addition to those that are rated high and specifically designated. In total, fifteen kipukas have been assigned as "park specials" including several "complexes", areas where its best served to survey multiple kipukas in one area. Currently three kipukas (Sand Kipuka, Carey Kipuka, and North Laidlaw Butte) all currently have small infestations of noxious weeds as of 2013 and they will need to receive annual survey efforts to rid them of these plants. Beyond that, the other 12 kipukas will be rotationally surveyed every three years to ensure they remain noxious weed free (see Appendix 2). Here's how many workdays were spent in 2013 on this objective at North Laidlaw Butte, Sand Kipuka, and Carey Kipuka:

Total workdays (2013)	# of people	# of days	Total
	5	6	30

30

Objective 2: Other High Priority Kipukas

A total of 75 other "high priority" kipukas beyond those determined to be "park specials" will need to be systematically surveyed to ensure they are noxious weed free. A number of these are grouped into "complexes" (groups of kipukas) so that survey efforts can be more efficient. Reviewing Appendix 2, note that three colors were used to define 2014, 2015, and 2016 anticipated survey efforts. Park staff will need to visit 27 kipukas in this category in 2014, 26 in 2015, and 22 in 2016 for a total of 75. Efforts will need to be efficient as there is a 3-4 week window in which noxious weeds, namely rush skeletonweed, are easy to identify.

No work days were devoted to this objective in 2013.

Total workdays (2013)	# of people	# of days	Total
	-	-	-