



Rehabilitate Sun Notch Trail Landscape Project

2022 Annual Report



**ON THIS PAGE**

Crater Lake National Park staff and the Northwest Youth Corps planting native vegetation to restore an old, decommissioned trail bed near the Sun Notch Trail. Photo by Carrie Wyler.

ON THE COVER

Decommissioned trail across the Sun Notch meadow. Photo by Carrie Wyler.

Rehabilitate Sun Notch Trail Landscape Project

2022 Annual Report

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This annual report series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by a subject matter expert who was not directly involved in the collection, analysis, or reporting of the data.

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Abstract

The Rehabilitate Sun Notch Trail Landscape project corrects issues stemming from visitor use damage along a popular front-country trail. This includes disturbance originating from a 2012 trail reroute, continual social trail creation, and vegetation trampling. Work completed during the 2022 field season includes installation of fencing; collection of 615 grams of native seed; propagation and care of 1,091 containerized native plants; propagation of an additional 196 native plants; planting of 1,005 native plants in restoration areas; invasive vegetation surveys in the project area; and social trail obliteration. In 2023 vegetation monitoring, seed collection, and additional planting and seeding to augment revegetation efforts will continue.

Acknowledgments

This project was made possible through support provided by the National Park Service Recreation Fee program. The Crater Lake National Park Facility Management division shared use of the Ball Diamond and South Yard staging areas for storage of plant materials and related infrastructure. Assistance with seed collection and planting was received from Scott Heisler, Hamilton Hasty, Casey Allen, Samantha Ulrich, Kyle Bianchi, David Larkin, Brian Pitt, Javonn Sims, and the Northwest Youth Corps. The U.S. Forest Service Dorena Genetic Resource Center aided with seed cleaning and storage.

Introduction

Crater Lake National Park's Sun Notch Trail was constructed in 1919 to provide access to a locale along the caldera rim offering outstanding views of Phantom Ship (Mark 2013). The Sun Notch Trail is located along East Rim Drive approximately four miles east of park headquarters (Figure 2). The Sun Notch Trail is one of the most popular park trails receiving approximately 24,500 hikers per year. In addition to providing an excellent vantage of the Phantom Ship geologic feature, it offers a hiking experience around a subalpine meadow to view Crater Lake and the dramatic cliffs of Sun Notch (Figure 1).



Figure 1. The meadows of the Sun Notch area (left); Phantom Ship as viewed from the Sun Notch Trail (right). Photos by Jen Hooke.

In 2012, the Sun Notch Trail was rerouted to guide hikers along a 0.8 mile loop around rather than through the subalpine meadow at the headwaters of the Sun Creek watershed. The original trail started from the Sun Notch trailhead parking lot and directed hikers straight uphill through the meadow to the caldera rim (Figure 3). In places this trail was excessively wide (Figure 2) and where it approached the caldera rim many social trails and heavy vegetation trampling were commonplace:

“After World War II, NPS planners identified the rim viewpoint at Sun Notch as a prospective tenth observation station for the Rim Caravan. The existing “trail,” however, is actually a network of social paths that lack design integrity and have caused unsightly impacts, particularly along the rim. Rehabilitation is essential and should consist of a curvilinear loop trail through the woods, one designed to discourage visitors from straying into the meadow before reaching the rim.” - Mark and Watson (2009)

In 2012, the park rerouted the trail around the meadow and decommissioned the old trail beds through the meadow using hand tools. Locally sourced woody debris and litter were scattered over the old trail beds and these sites were seeded with native grass and forb seed from the Sun Notch meadow. Limited funding was available for revegetation at the time of the trail reroute, and vegetation cover within the decommissioned trail beds has been slow to recover primarily due to

continued visitor use and foot traffic along the decommissioned trails. The Rehabilitate Sun Notch Trail Landscape project is a two-year effort to restore disturbed areas and improve the visitor experience through revegetating barren and sparsely vegetated areas that detract from the scenic beauty of the area. An estimated 0.15 acre of disturbed land will be restored as part of this project (Figure 3).



Figure 2. Top: Location of the Sun Notch Trail in the park. Map by Carrie Wyler. Bottom left: Original Sun Notch Trail in 2011 before decommissioning; note excessive trail width. Bottom right: Sun Notch Trail segment in 2013 after decommissioning; despite signage, hikers continued to use the old trail beds. Photos by Jen Hooke.

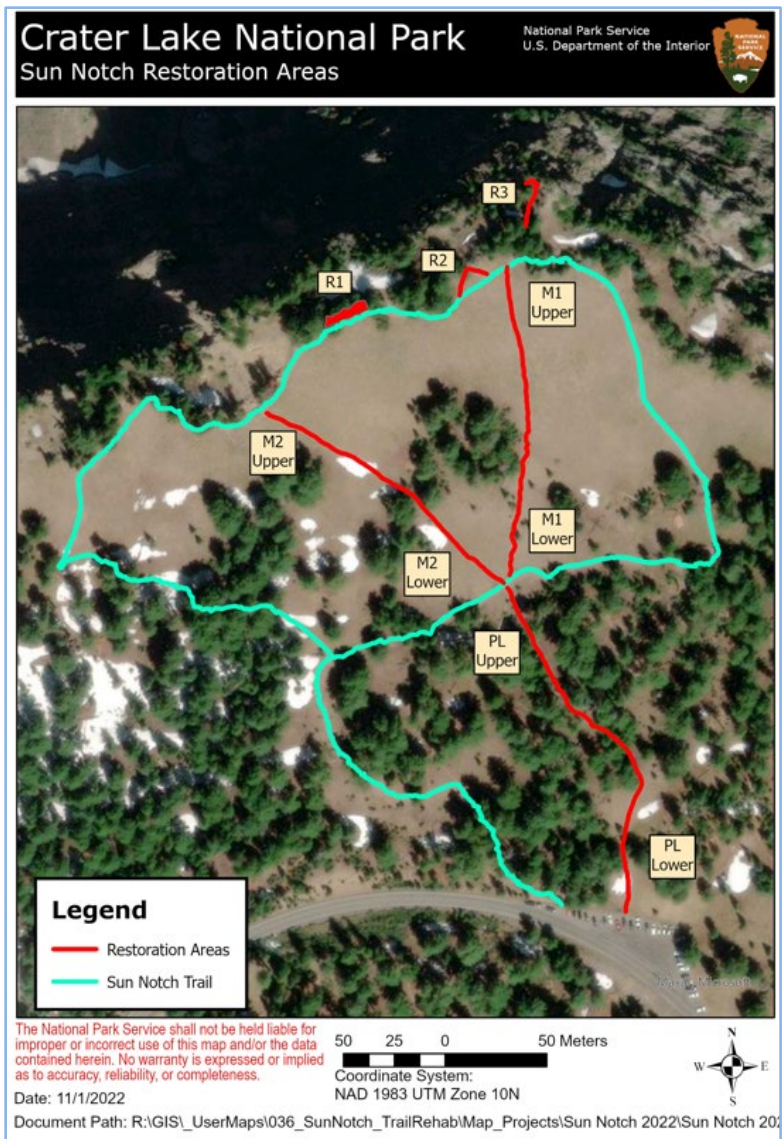


Figure 3. Left: The 2012 Sun Notch Trail reroute showing the new trail with a solid red line, and the original trail with a dashed black line. Map by Chris Wayne. Right: The 2022 Rehabilitate Sun Notch Trail Landscape restoration areas are marked with red lines. Map by Scott Heisler.

The Rehabilitate Sun Notch Trail Landscape project was split into three sections to help organize the work flow: meadow decommissioned trails (M1, M2), parking lot to meadow decommissioned trail (PL), and social trails on rim (R1-R3) (Table 1).

Table 1. Rehabilitate Sun Notch Trail Landscape restoration sites.

ID #	Location	Type	Size (ft ²)	Restoration Actions
M1	Meadow trail to rim (East)	Decommissioned trail	1,536	STO*, seed, plant
M2	Meadow trail to rim (West)	Decommissioned trail	1,437	STO*, seed, plant
PL	Parking lot to meadow	Decommissioned trail	1,830	STO*, seed, plant
R1	Large, disturbed area at caldera edge	Social trail	1,182	STO*, seed
R2	Old U-shaped social trail at caldera edge	Social trail	237	STO*, seed, plant
R3	Social trail heading into caldera	Social trail	288	STO*

**Social Trail Obliteration (STO)*

Goals of the current rehabilitation project are:

1. Developing revegetation prescriptions and a revegetation plan for disturbed areas
2. Installing temporary fencing at both the top and bottom points of entry, including two cross-meadow decommissioned trails and one decommissioned trail leading from the parking lot. Installing revegetation site signage.
3. Collecting and cleaning native seed for revegetation efforts
4. Propagating and caring for native containerized plants for revegetation
5. Surveying for and controlling nonnative plant species within the project area
6. Obliterating and decompacting social trails and deterring future disturbance and use
7. Planting and seeding native vegetation in disturbed areas
8. Monitoring restored areas for revegetation efficacy and augmenting restoration actions

Restoration of disturbed areas (Figure 4) is necessary to facilitate natural succession of vegetation communities, protect the meadow habitat, protect slopes from soil erosion, and prevent invasion by nonnative plant species.

The 2022 field season focused on documenting disturbed areas and preparing restoration site prescriptions, installing temporary fencing, gathering plant materials, obliterating social trails and decompacting soils, and seeding and planting restoration sites with native plant materials. Five seasonal Biological Science Technicians (Plants) were partially funded by the Rehabilitate Sun Notch Trail Landscape project in 2022; season length was from May 24 – September 30.



Figure 4. Planting in areas of heavy visitor use (left). Using fencing, signs, and woody debris to deter use of a social trail leading into the caldera (right). Photos by Carrie Wyler.

Methods

Revegetation efforts by the Botany program for this project consist of six components: (1) revegetation prescriptions development, (2) seed collection, (3) plant material propagation and plant care, (4) invasive vegetation management, (5) social trail obliteration and fencing, and (6) seeding and planting.

Revegetation

Site Prescriptions

Revegetation prescriptions were developed for restoration sites using adjacent undisturbed plant communities for reference. The prescriptions serve to document the disturbance, site features, and plant community composition unique to each site. Prescriptions were developed by making visits to each site and recording the dominant plant species with an ocular estimate of each species' relative cover. This documentation informs revegetation efforts by providing a baseline from which to determine the number of plants and amount of seed to be used at each site. The revegetation prescriptions guide the planting and seeding plans for restoration work. The specifics of this process are outlined in a project-specific revegetation plan (Wyler and Hooke 2022). Revegetation prescriptions and the revegetation plan are housed on the Botany file server at park headquarters.

Seed Collection

Using the 2022 revegetation prescriptions as a guide, seed was collected from graminoids, forbs, and shrubs within the project area. Seed collection in 2022 targeted the most abundant plant species in the project area, and ones that the Botany program has experienced the most success with propagating and planting in prior restoration projects. Some revegetation will be accomplished by relying on the existing seed bank and seed rain from adjacent native plant populations (Table 2). The seed collection process commenced in 2022 by observing and documenting the phenology of each targeted species in the project area.

Table 2. Seed collection plant taxa list for the Rehabilitate Sun Notch Trail Landscape project.

Scientific Name	Common Name
<i>Bromus sitchensis</i> var. <i>carinatus</i>	California brome
<i>Calyptidium umbellatum</i>	Pussypaws
<i>Carex inops</i> ssp. <i>inops</i>	Long-rhizome sedge
<i>Carex pachycarpa</i>	Many-rib sedge
<i>Castilleja arachnoidea</i>	Cobwebby paintbrush
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	Common squirreltail
<i>Elymus glaucus</i> ssp. <i>glaucus</i>	Blue wildrye
<i>Ericameria greenei</i>	Greene's goldenbush
<i>Eriocoma occidentalis</i>	Western needlegrass
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Marumleaf buckwheat
<i>Eucephalus ledophyllus</i>	Cascade aster
<i>Gayophytum diffusum</i> ssp. <i>parviflorum</i>	Nuttall's groundsmoke
<i>Koenigia davisiae</i> var. <i>davisiae</i>	Davis' knotweed
<i>Lupinus albicaulis</i> var. <i>shastensis</i>	Pine lupine
<i>Phacelia hastata</i> var. <i>compacta</i>	Compact phacelia

When seeds were mature, they were collected, dried, and stored until shipment or cleaning. Large quantities of seed were shipped to the USFS Dorena Genetic Resource Center (DGRC) for cleaning, while smaller quantities were cleaned in house. A single bag was used to collect all the seed from an individual species if the species was to be used for propagation purposes (Figure 5); otherwise, species were combined into seed mixes for ease of collection. Collection bags were labelled with plant species code and collection date. After collection, seeds were transported to the seed drying and storage facility in the Nine Stall garage at park headquarters (Figure 5). Collected seed was placed inside 30-gallon plastic storage totes secured with window screen at the top, allowing ventilation while reducing chances of predation. Plant taxa with very small seeds were first placed in smaller plastic bins before being stored within the larger 30-gallon tubs. The tubs were labelled and organized on shelves by seed zone and plant species (Figure 5).



Figure 5. Collected seed before cleaning (left). Seed drying and storage facility at park headquarters (middle). Seed drying in a container inside a drying bin with ventilated lid (right). Photos by Carrie Wyler.

Propagation and Plant Care

Plants were propagated in the fall and then cold stratified during the winter months at the Ball Diamond nursery at park headquarters (Figure 6). Once the snow melted, plants were covered with a shade house (40' x 20' x 10' – Figure 6). Plant propagation included containers of grasses, sedges, and forbs.

Containerized plants were fertilized with Osmocote 14-14-14 slow-release fertilizer. Fertilizer was applied at the beginning of the season when plants emerged from the snow at a rate of 1/8 tsp per planting tube. Descriptions of fertilization procedures can be found in Botany program files in the “Nursery Activities” binder. Any reproductive structures were removed to promote root development and prevent excess evapotranspiration, and dead growth was removed to discourage fungal growth.



Figure 6. Propagated pots with animal exclusion screening on top (top). Shadehouse where propagated plants are stored at the Ball Diamond nursery (bottom). Photos by Carrie Wyler.

Assistance with obtaining plant materials and cleaning seed for this project is being obtained through an interagency agreement between CRLA and the DGRC to clean, propagate, and store large quantities of seed. Plant materials for this project will continue to be collected through 2023.

Planting and Seeding

A mix of plant taxa were planted in the disturbance areas in accordance with the prescriptions and actual availability of plant materials. At restoration sites, holes were dug to a depth equal to or greater than the length of the planting tubes. Plants were carefully removed from the tubes by pressing on the sides or tapping the rim of the tubes while they were inverted over the planting holes. After the plants had been removed, the roots were inspected for any signs of being root bound, having roots growing upward in the tube (“J”-rooting), or root girdling. If any of these were found, the roots were either trimmed or gently teased apart to encourage root growth and plant establishment. The plants were then placed in planting holes to ensure they were upright perpendicular to the pull of gravity (not relative to the local topography). Soil was then pushed back into the planting holes and tamped down gently to remove any air pockets in the soil. Plantings were installed so that the root collars of the plants were just at or slightly below the surface of the soil. Remaining soil or additional soil from the surrounding area was used to create a berm wall around the plants to facilitate water retention and help stabilize and protect plants. One or two handfuls of compost were then placed in the center of the rings around plants (Figure 7). After mulching, the plants were watered from water jugs that were hiked into the site (Figure 7). Planting rates are figured at planting one third of the area, with plants being spaced 12-24” from each other (measured from plant center; plus 10% added to account for plant death). Once these plants have become established, they should revegetate the remaining area with seed rain.

A site-specific seed mix combined with compost (Figure 7) was prepared and hand-broadcast over planted areas and raked into the soil after planting was completed. Common target rates of seed application in revegetation projects are 60 to 90 live seeds per square foot. Each restoration area receives a custom seed mix that is appropriate to its revegetation prescription. After hand broadcasting, seed was raked into the upper ¼ to ½ inch of topsoil. Revegetation sites will be monitored, and barren or failed areas will be filled in as needed in future years.



Figure 7. Prepared seed mixed with compost (left). Berm and mulch surrounding planting (middle). Carrying water jugs with frame pack into restoration planting sites (right). Photos by Carrie Wyler.

Invasive Vegetation Management

The Rehabilitate Sun Notch Trail Landscape project area contains no known nonnative plant species, but some invasive plants could be introduced through visitor use and will be managed aggressively if detected. Invasive plant surveys, monitoring, and control will be conducted annually by Botany staff. All invasive plants present will be treated according to CRLA protocols. Since the project area contains no known invasive plants, any invasive plant populations detected within the project area will be subject to an eradication strategy. The park utilizes manual and chemical methods for invasive plant control; the Invasive Vegetation Management Plan (DOI NPS 2017) guides invasive plant treatments in the park.

Social Trail Obliteration and Fencing

Areas disturbed by social trails and previously decommissioned trail beds were restored by re-shaping and scarifying areas with compacted soils. In forested areas, visitor trespass disturbance was restored via woody debris placement and obstruction of paths; vertical mulching practices were used in areas of high traffic to dissuade entry and provide a physical deterrent. In meadow restoration areas, crews refrained from using more woody debris to rehabilitate the decommissioned trail beds. In these areas revegetation was accomplished by both seeding and planting of native plants. This practice encouraged the reestablishment of native vegetation cover while relying on fencing and signage to discourage future visitor use.

Temporary fencing and signage measures were installed to encourage visitors to remain along designated trails and to deter further degradation of revegetation sites (Figure 8). Fencing measures used in other areas of the park were utilized for the Rehabilitate Sun Notch Trail Landscape project to maintain a consistent look throughout the park. This fencing is installed each year in the spring and removed in the fall due to the heavy snowpack experienced at this area. To ensure the stability of fencing posts, it was determined that in-ground post receivers were necessary to support posts and facilitate installation each spring. Information on suppliers, order specifications, and installation procedures is on file in the Botany office at park headquarters.



Figure 8. Left: Original meadow trail before decommissioning in 2012. Photo by Jen Hooke. Right: The same trail with temporary fencing and signage installed in 2023. Photo by Carrie Wyler.

Results

Revegetation

Site Prescriptions

In 2022, nine restoration sites were defined, each with a unique revegetation prescription based on pre-disturbance conditions (Table 3). Both meadow decommissioned trails (M1 & M2) were segmented into an upper and lower restoration site as well as the PL site to correspond with unique vegetative communities present at each site. Complete site documentation forms for all sites can be found on the Botany file server.

Table 3. Example of a revegetation prescription for the Rehabilitate Sun Notch Trail Landscape project.

Seed Zone: Sun Notch		ID: M2-upper	Unplanned site
Location: Meadow social trail to Rim, West side of meadow			
Site Description: Upper disturbed area of social trail			
Pre-Disturbance Site Information			
Plant Taxa	Common Name	Relative % Cover	
<i>Koenigia davisiae</i> var. <i>davisiae</i>	Davis’s knotweed	30	
<i>Eucephalus ledophyllus</i>	Cascade aster	10	
Grass mix: <i>Elymus elymoides</i> ssp. <i>elymoides</i> , <i>Elymus glaucus</i> ssp. <i>glaucus</i> , <i>Eriocoma occidentalis</i> , <i>Bromus sitchensis</i> var. <i>carinatus</i>	Grass mix	40	
<i>Carex pachycarpa</i>	Many-rib sedge	5	
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Marumleaf buckwheat	2	
<i>Carex inops</i> ssp. <i>inops</i>	Long-rhizome sedge	5	
<i>Other</i>		8	
	Total Cover:	100%	
Associated species: <i>Agoseris</i> species, <i>Gayophytum diffusum</i> ssp. <i>parviflorum</i> , <i>Ericameria greenei</i> , <i>Calyptridium umbellatum</i> , <i>Viola</i> species, <i>Linanthus pungens</i> , <i>Lupinus albicaulis</i> var. <i>shastensis</i> , <i>Phacelia hastata</i> var. <i>compacta</i> , <i>Carex halliana</i> , <i>Castilleja arachnoidea</i>			
UTM (Zone 10, NAD 83):	Beginning: N573790	End: E4750349	
Total Vegetative Cover: 45%		Elevation: 7137 ft.	
Slope: Medium	Aspect: East	Snowmelt out: early June	
Soil “hardness,” presence of rocks: medium compaction			
General Soil description: sandy			
Ameliorating microsite features: existing vegetation, fine woody debris – sticks, lots of detritus			
Wind exposure: Low-Medium	Canopy cover (overall): Low		
Area: 1437 ft ²			
Comments: Prescription from middle of meadow to top of trail			
Recorder: CW, ER		Date: 07/19/22	

Seed Collection

Plant phenology was monitored during the field season through biweekly visits to collection sites, and then later in the season concurrently with seed collection. In 2022 seed collection for the project commenced in early August and continued into late October. The peak seed collection for the bulk of plant species occurred from mid-August to mid-September (Table 4).

Table 4. 2022 seed collection periods for priority collection species indicated by gray shading.

Scientific Name	(early) AUG	(mid) AUG	(late) AUG	(early) SEPT	(mid) SEPT	(late) SEPT	(early) OCT	(mid) OCT	(late) OCT
<i>Bromus sitchensis</i> var. <i>carinatus</i>									
<i>Carex pachycarpa</i>									
<i>Elymus glaucus</i> ssp. <i>glaucus</i>									
<i>Ericameria greenei</i>									
<i>Eriocoma occidentalis</i>									
<i>Eriogonum marifolium</i> var. <i>marifolium</i>									
<i>Eucephalus ledophyllus</i>									
<i>Koenigia davisiae</i> var. <i>davisiae</i>									
<i>Phacelia hastata</i> var. <i>compacta</i>									

In 2022, Botany staff collected seed from plants on the project's species collection list; quantities are listed in Table 5. Grasses and sedges produced abundant seed that was easy to collect, and thus made up the bulk of the seed collection. Plant taxa that were collected in lower quantities include groundsmoke (*Gayophytum diffusum* ssp. *parviflorum*), cobwebby paintbrush (*Castilleja arachnoidea*), pine lupine (*Lupinus albicaulis* var. *shastensis*), and Greene's goldenbush (*Ericameria greenei*) as variable weather conditions and animal predation reduced both quantity and quality of available seed.

Table 5. Seed collection and dispersal quantities for the Rehabilitate Sun Notch Trail Landscape project.

Scientific Name	Common Name	Amount collected 2022 (grams)	Amount dispersed 2022 (grams)
<i>Carex pachycarpa</i>	Many-rib sedge	285	148
<i>Castilleja arachnoidea</i>	Cobwebby paintbrush	1	0
<i>Elymus glaucus</i> ssp. <i>glaucus</i>	Blue wildrye	30	0
<i>Ericameria greenei</i>	Greene's goldenbush	5	0
<i>Eriocoma occidentalis</i>	Western needlegrass	80	45
<i>Eriogonum marifolium</i> var. <i>marifolium</i>	Marumleaf buckwheat	133	88

Scientific Name	Common Name	Amount collected 2022 (grams)	Amount dispersed 2022 (grams)
<i>Eucephalus ledophyllus</i>	Cascade aster	37	33
<i>Gayophytum diffusum</i> ssp. <i>parviflorum</i>	Nuttall's groundsmoke	1	0
<i>Koenigia davisiae</i> var. <i>davisiae</i>	Davis' knotweed	101	80
<i>Lupinus albicaulis</i> var. <i>shastensis</i>	Pine lupine	7	0
<i>Phacelia hastata</i> var. <i>compacta</i>	Compact phacelia	2	0
	TOTAL	682	394

Propagation and Plant Care

After the snow melted in 2022, plants in the Ball Diamond nursery were assessed and inventoried. Pots without any green growth were discarded. Plants with detritus, moss, liverworts, or volunteer plants were cleaned throughout the season (Figure 9).

In the fall of 2022, pots were seeded to provide additional containerized plants for the 2023 season. These plants are being held over the winter at the Ball Diamond nursery to fill in revegetation gaps as needed during the 2023 season. These plants will need care during the summer of 2023 including watering and fertilization. Detailed reports of daily nursery activities are on file in the Botany office in the Nursery Activities binder. Approximately 196 containers were seeded to provide plant materials for the 2023 planting season (Table 6).

Table 6. Plant propagation numbers as of fall 2022.

Scientific Name	Common Name	# Of pots seeded for propagation in 2022
<i>Carex pachycarpa</i>	Many-rib sedge	98
<i>Eriocoma occidentalis</i>	Western needlegrass	98
TOTAL		196



Figure 9. Overwintered plants emerging from the snow (left). Cleaning and trimming plants (middle). Plant care at the park's nursery (right). Photos by Carrie Wyler.

Planting and Seeding

Revegetation work began in the fall of 2022 with soil decompaction, planting, and seeding in areas PL1, M1, M2, and R2. A total of 1,005 plants were planted and 317 grams of seed dispersed across all sites (Table 7). Sites R1 and R3 were seeded and obscured with woody debris.

Table 7. Restoration plantings in 2022 at each restoration zone.

Scientific Name	Restoration Zones				Total plantings
	M1	M2	PL1	R2	
<i>Bromus sitchensis</i> var. <i>carinatus</i>	40	62	0	0	102
<i>Carex pachycarpa</i>	80	100	10	16	206
<i>Elymus elymoides</i> ssp. <i>elymoides</i>	80	133	56	12	281
<i>Elymus glaucus</i> ssp. <i>glaucus</i>	40	77	0	6	123
<i>Eriocoma occidentalis</i>	80	136	54	16	286
<i>Koenigia davisiae</i> var. <i>davisiae</i>	0	7	0	0	7
TOTAL	320	515	120	50	1,005

Following planting, the sites were broadcast seeded and these seeds carefully raked in at each restoration site. Plantings were watered as needed, which was challenging as fall storms were late to arrive and water had to be hiked into the restoration sites. As work progresses through the 2023 season, areas will be monitored for success and follow-up planting and seeding will occur as appropriate.

Invasive Vegetation Management

The Rehabilitate Sun Notch Trail Landscape project area contains no known invasive plants, but potential exists for invasive plants to be introduced through visitor use. The project area was surveyed in the spring and summer of 2022 and no infestations were found. The area will continue to be surveyed in future years to ensure that disturbed areas are not subject to invasive plant establishment.

Social Trail Obliteration and Fencing

In spring of 2022 fence post receivers were placed at both the top and bottom of both decommissioned meadow trails and the decommissioned trail leading to the parking lot. With in-ground receivers in place, powder coated fence posts were installed and chain strung through all receivers (Figure 10). In the fall, posts and chain were removed and winter caps placed on top of receivers. This process will need to be repeated in the spring of 2023 and for the foreseeable future until a more permanent fencing solution is found to deter visitor trampling of the Sun Notch meadow. To encourage visitors to remain on designated trails, woody debris and signs were placed at the origin of social trails to reduce confusion as to the desired visitor circulation pattern. Signs and woody debris will need monitoring and maintenance in future years.

Due to the high visitor trespass along the Sun Notch Trail, smaller social trails were documented and restored. Areas R1-R3 received social trail obliteration treatments with minor planting. All social trails leading into the caldera were prioritized for restoration due to safety concerns.



Figure 10. Installation of new fencing (left) and social trail obliteration along caldera rim (right). Photos by Carrie Wyler.

Discussion

During the 2022 season revegetation and restoration work was completed for the first year of the project. Work will continue into the 2023 field season with additional site protection through fencing and signage, and a final season of fall planting and seeding to revegetate barren sites. Challenges encountered during the 2022 field season included the somewhat remote nature of the trail landscape revegetation environment. All plants, tools, equipment, etc. had to be hauled into revegetation sites by hand or using a hand-pulled wagon for transport. Additionally, all plantings had to be hand-watered by hiking water jugs into the site. Typically, revegetation work at the park occurs in the fall so that watering is achieved naturally by fall storms. However, an uncharacteristically warm and dry fall resulted in the need for continued watering for the entire month of October, including past the ending season dates for most of the seasonal revegetation crew.

Recommendations and needs for the Rehabilitate Sun Notch Trail Landscape Revegetation work during the 2023 field season include:

- Fencing and signage will need to be installed in the spring of 2023 as soon as snowmelt allows.

- All plants propagated in fall of 2022 will need to be assessed for status and health and cared for throughout the 2023 season. All containerized plants should be checked for moss, liverwort growth, and weeds and they should be removed if present.
- The entire project area needs to be thoroughly surveyed for invasive plants at least twice throughout the 2023 field season.
- The area will need to be monitored in 2023 for revegetation success and determine if further planting is needed. There may be higher mortality of plantings than what is typically experienced due to a long, dry fall in 2022.
- Sites M1 and M2 will need to be monitored to determine whether visitor trespass continues with new fencing installation.
- All remaining seed should be dispersed and raked in where barren areas remain or plantings experienced mortality.
- Due to the heavy visitor use received by this area and the high probability of continued visitor trespass, it will need to be monitored annually for social trail development and damage.

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