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Crater Lake National Park

Rim Trail Revegetation Project

2019 Annual Report

ON THIS PAGE
Excessively wide section of the Rim Trail encourages trampling and has almost eliminated vegetation cover.
Photo by Jen Hooke

ON THE COVER
Sparse vegetation cover due to visitor trampling adjacent to the Rim Trail corridor.
Photo by Jen Hooke

Rim Trail Revegetation Project

2019 Annual Report

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April 2020

U.S. Department of the Interior
National Park Service
Crater Lake National Park
Crater Lake, Oregon

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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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https://irma.nps.gov/DataStore/Reference/Profile/2272692

Please cite this publication as:

Heisler, S.E., C.S. Wyler, and J.S. Hooke. 2020. Rim Trail Revegetation Project: 2019 Annual Report. Crater Lake National Park, Crater Lake, Oregon.

April 2020

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Abstract

In 2019, the Botany program at Crater Lake National Park received funds to repair visitor-use damaged landscapes immediately adjacent to the park's Rim Trail. This project was planned to complement cyclical trail maintenance efforts, with the intent of restoring areas of trampled vegetation and compacted soils created by the numerous social trails and excessively large viewpoints along the length of the trail. Damaged areas identified within the project's boundaries total over five acres. Work conducted in 2019 by the Botany program focused on project area assessment, revegetation (native seed collection and processing, plant propagation), and social trail obliteration. Results consisted of the partial development of a restoration framework; collection and processing of 12,127 g of native seed from three distinct seed collection zones; care of 2,569 containerized native plants propagated in fall 2018; sourcing propagation of an additional 4,746 plants; and a preliminary round of social trail obliteration at fifteen sites totaling approximately 0.7 acres.

Acknowledgments

This project was supported by the National Park Service Recreation Fee program. Jack Northcutt assisted with finalizing an interagency agreement with the U.S. Forest Service Dorena Genetic Resource Center. Lisa Winn and Lee Riley of the Dorena Genetic Resource Center assisted with plant propagation. Melody Frederic, Carson Ralls, Benjamin Wright, Delacey Randall, Elena Olsen, Hamilton Hasty, Sarah Hogan, Vance McNees, and Matthew Jelinske helped with seed collection and social trail obliteration.

Introduction

Crater Lake National Park's (CRLA) Rim Trail provides visitors a unique opportunity to experience Crater Lake as a primitive landscape. Beginning at CRLA's historic Rim Village, the trail traverses 7.6 miles along the western edge of the caldera rim to the trail's northern terminus at North Junction (Figure 1). Along the way, visitors are immersed in a landscape of old growth forest, colorful meadows, rugged peaks, and windswept fellfield. Frequent breaks in the forest open to precipitous views of the caldera's sculpted inner walls and the sweeping expanse of stunningly blue Crater Lake. The quality of an immersive experience in nature's beauty befitting a national park is at its peak here, placed within a context which lends perspective to the scale of the landscape and forces that shape it.

The Rim Trail originated as a short 1.5-mile segment constructed in 1932 connecting Rim Village and Discovery Point, called the Discovery Point Trail (Mark 2013). Decades passed before the Discovery Point Trail was extended north along the caldera rim to North Junction. New trail construction was minimized by aligning as much of the new trail as possible with the old Rim Road. The completion of this project occurred in 1994, and the new trail was called the "PCT Alternate" route as it provided an option for Pacific Crest Trail (PCT) hikers to experience views of Crater Lake before joining back up with the PCT at North Junction (Mark 2013). The name "Rim Trail" came to encompass the entire 7.6 mile stretch from Rim Village to North Junction around 2000 (Mark, personal communication).

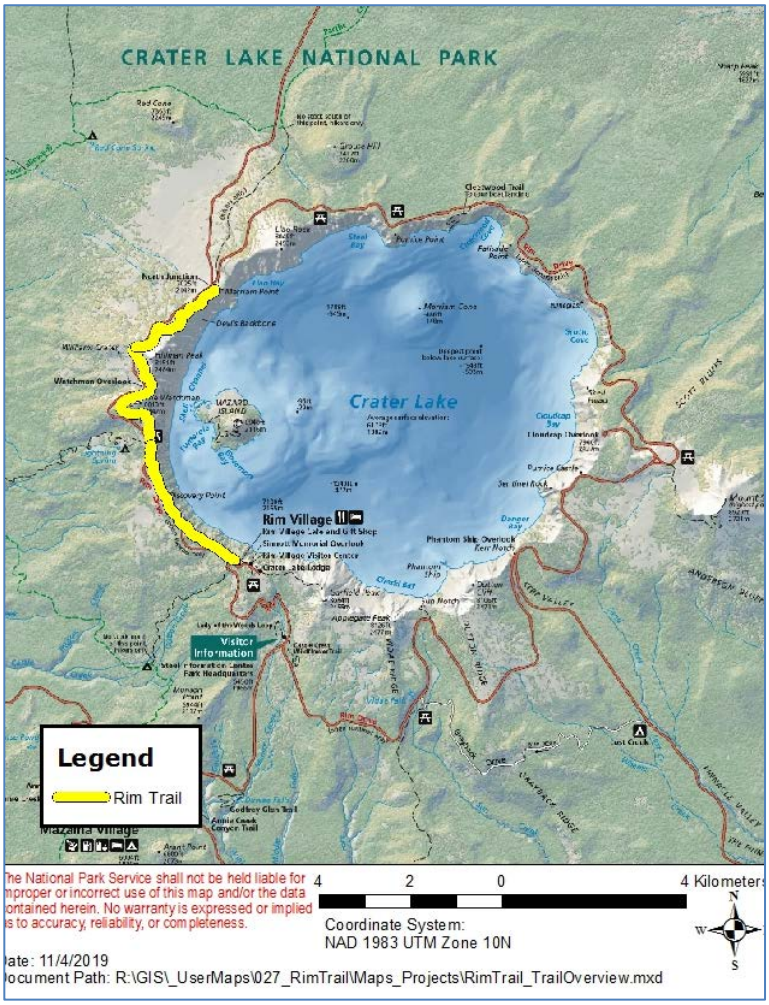

Figure 1. Highlighted area is the Rim Trail at Crater Lake National Park. Map by Scott Heisler.

The Rim Trail is one of the most popular trails at CRLA. Decades of intense use by visitors, with CRLA now frequently setting new records for annual visitation, have combined with a lack of maintenance to render large areas of the trail in a heavily degraded condition. Extensive social trails; broad, barren trampled areas; and diverted sections of tread have proliferated along the trail, with especially high levels of degradation in areas surrounding established access points such as pullouts and picnic

areas along West Rim Drive. In addition to detracting from the aesthetics of the trail, this damage compromises visitor safety by decreasing the stability of the trail and directing traffic into hazardous areas along the cliffs of the inner caldera (Figure 2).

Figure 2. A social trail leads from the Rim Trail inside the Crater Lake caldera. Photo by Jen Hooke.

In 2019, CRLA's Botany program received funds to repair damaged landscapes immediately adjacent to the Rim Trail. This project is designed to complement cyclical maintenance efforts performed by the Trails crew. Coupling revegetation work with trail maintenance while improving visitor access and safety is an effective strategy to restore the landscape for the enjoyment of visitors for generations to come. Unfortunately, priorities for the Trails crew shifted in 2019 and they focused on intense rehabilitation of only the first 0.10 mile of the Rim Trail starting at Rim Village. Their work on the remainder of the Rim Trail begins in 2020. This shift in work priorities for the Trails crew subsequently delayed the Botany side of the rehabilitation project, as trail maintenance work needs to precede revegetation efforts.

The goals of the Botany program's efforts in this project are to repair barren sites and areas impacted by social trails through decompacting and amending soils; increasing vegetation cover and abundance; and discouraging additional disturbances in these areas through education and obstruction. The funds received for this project support salary and supply costs for seasonal Biological Science Technicians to achieve the following tasks:

- Assess and map damaged landscape areas suitable for revegetation efforts
- Help develop plant material collection zones and lists of plant species targeted for seed collection
- Help develop a revegetation plan for seed collection, site repair, broadcast seeding, and planting
- Collect native seeds and plant materials from adjacent wildlands
- Dry, clean, process, and store collected plant materials
- Prepare seed mixes for broadcast seeding

- Help propagate native herbaceous and shrubby plants for restoration plantings
- Broadcast seed of native grasses, forbs, sedges, and shrubs
- Rehabilitate disturbed soils through adding native organic materials such as Park-sourced compost and woody debris
- Social trail obliteration and restoration of barren and denuded areas
- Install signs and natural barriers to keep visitors on designated trail and overlook areas
- Monitor efficacy of restoration efforts and augment seeding/planting as needed to restore barren areas
- Produce annual reports outlining efforts and findings

Efforts during the 2019 field season focused on three distinct components of the project: project area assessment, revegetation (native seed collection and processing, plant propagation), and social trail obliteration. These components will be discussed separately in the following sections.

Methods

Project Area Assessment

A formal assessment and mapping of revegetation sites within the project area was conducted in early September 2019. This assessment identified and characterized problem areas, gathered area measurements, and identified plant communities for use in plant material procurement. A final list of revegetation sites will need to be complied before intensive restoration work is conducted. This process will require coordination with the Trails program, as many sites will require the trail to be clearly defined and of a desired width for revegetation efforts to succeed (Figure 3). Following finalization of a site list, formal revegetation prescriptions can be created to guide efforts within sites.

Figure 3. Excessively wide sections of the Rim Trail require work to address trail deficiencies (e.g., lack of trail demarcation, bloated width) prior to the commencement of revegetation work. Photo by Jen Hooke.

Revegetation

Native Seed Collection and Processing

Due to the proximity in location, the seed collection zones previously developed for the adjacent Rim Drive Rehabilitation Revegetation project (Figure 4) were used for the Rim Trail project. Within these zones, seed was collected from the area within a half mile of the trail. Species collection lists were developed by surveying plant communities along the trail and assessing the Botany program's success with the use of individual species in previous revegetation efforts. Phenology of the collection species within the seed collection area was recorded during the 2019 field season and is detailed in Table 1.

Table 1. 2019 observed phenology for Rim Trail seed collection species.

2019 Observed Phenology of Seed Collection Species					
Species	**Leaf**	**Bud**	**Flower**	**Fruit**	**Seed**
Achnatherum occidentalis	24-Jun	8-Jul	5-Aug	19-Aug	23-Aug
Aconogonon davisiae var. *davisiae*	**	24-Jun	8-Jul	5-Aug	19-Aug
Bromus carinatus var. *carinatus*	24-Jun	22-Jul	29-Jul	5-Aug	12-Aug
Calyptridium umbellatum	**	**	**	**	22-Jul
Carex breweri	**	8-Jul	22-Jul	5-Aug	23-Aug
Carex halliana	**	**	**	19-Aug	10-Sep
Carex inops	**	**	**	22-Jul	26-Aug
Carex pachycarpa	**	**	**	8-Jul	26-Aug
Elymus elymoides ssp. *elymoides*	24-Jun	8-Jul	29-Jul	12-Aug	23-Aug
Elymus glaucus ssp. *glaucus*	**	**	**	**	12-Sep
Ericameria greenei	24-Jun	5-Aug	19-Aug	**	26-Sep
Erigogonum pyrolifolium var. *coryphaeum*	**	**	**	24-Jul	26-Aug
Eriogonum marifolium var. *marifolium*	**	**	2-Jul	24-Jul	27-Aug
Lupinus andersonii	24-Jun	8-Jul	22-Jul	5-Aug	19-Aug
Lupinus lepidus var. *lobbii*	24-Jun	8-Jul	22-Jul	5-Aug	19-Aug
Phacelia hastata ssp. *compacta*	**	18-Jun	1-Jul	29-Jul	26-Aug
Phlox diffusa	24-Jun	8-Jul	22-Jul	29-Jul	8-Aug
Polygonum shastense	**	**	**	6-Sep	26-Sep

** = *no data collected*

Seed was collected according to the Botany program's established Seed Collection Protocols (Beck et al. 2017). This seed was then dried and cleaned according to the Botany program's Seed Cleaning and Short-Term Storage Protocol (on file on the Botany server).

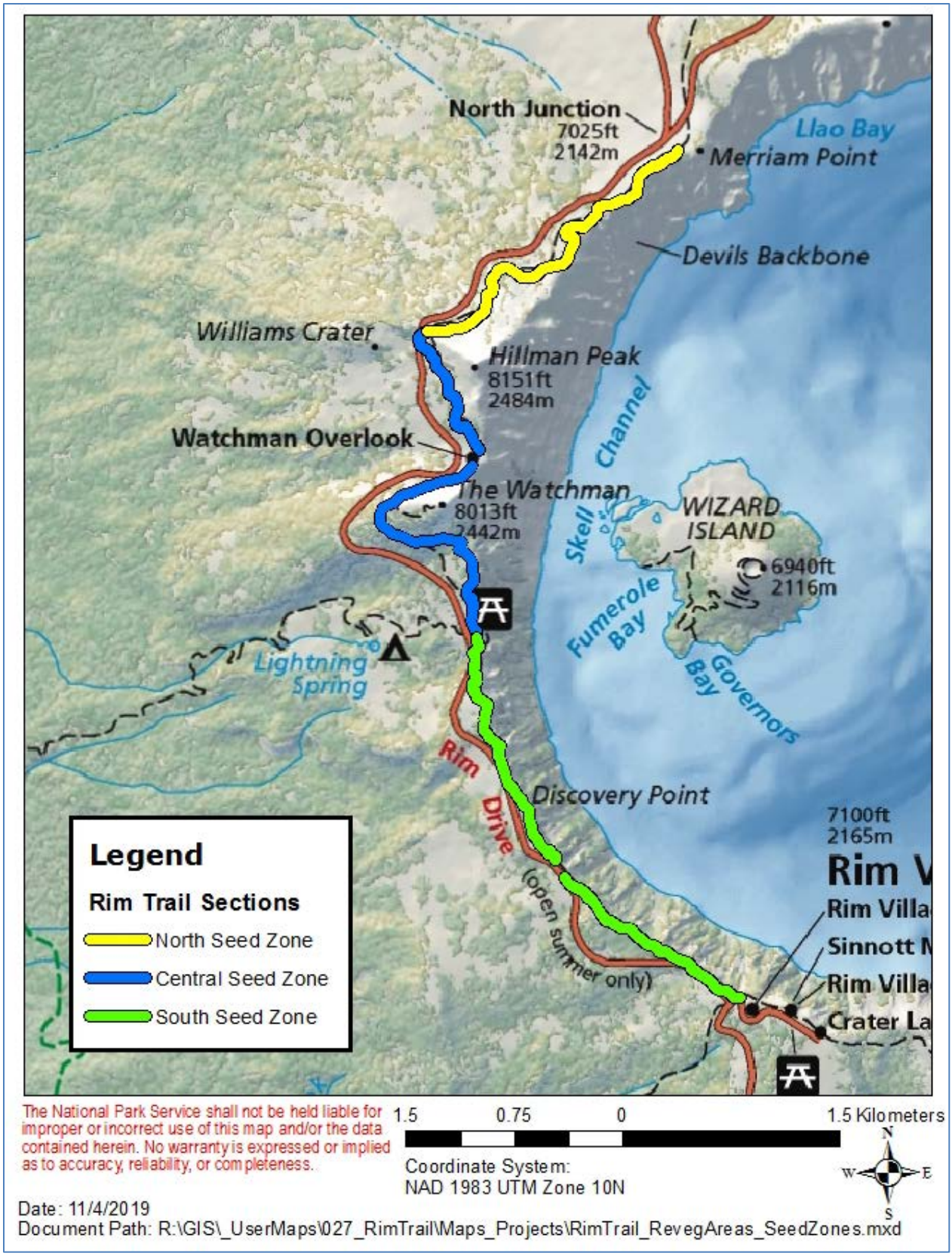

Figure 4. Rim Trail sections and seed zones. Map by Scott Heisler.

Plant Propagation

Anticipating the need for established containerized plants for use by this project and the slow growth of native plants in the high elevation conditions at CRLA, an advance round of plant propagation was conducted in fall 2018 (Table 3). A method of plant propagation previously established by the Botany program was utilized to address staffing and equipment limitations (Heisler et al. 2019). This method uses the reliable snowpack at CRLA for cold stratification of pre-seeded pots. Selection of plant species and quantities for this effort were based upon the program's familiarity with the project area and experience gained from the Rim Drive Rehabilitation Revegetation project.

In October 2018 and 2019, Ray Leach "SC7 Cone-tainer" pots were placed in racks and then filled and settled to 0.5" below the top rim with Premier "PRO-MIX HP Mycorrhizae" soil. These pots were then seeded with native seeds collected from the restoration area during the 2018 and 2019 field seasons (Figure 5). A thin (~1/8") layer of soil was then placed over the seeds, and the pots were watered to settle the contents. The seeded pots were placed under rodent-excluding screens in the Botany program's space at the Ball Diamond at Park headquarters and left to overwinter under the snowpack to replicate natural germination conditions. Prior to overwintering, pots were placed in a tight group, and mulch was packed around the perimeter to protect roots from exposure to severe cold and desiccation (Figure 5). During the 2019 field season, the germinated plants were cared for according to the Botany program's established native plant nursery protocols (on file on the Botany server).

Figure 5. Seeding pots for plant propagation (left). Consolidating pots and surrounding them with mulch for overwintering (right). Photos by Carrie Wyler.

Additional plant material needs for this project will be predominantly sourced through an interagency agreement with the Dorena Genetic Resource Center (DGRC). Of note, propagation from stem cuttings of pinemat manzanita (*Arctostaphylos nevadensis*) by the DGRC will require collection of cuttings in spring 2020.

In addition to managing a full native plant nursery, the DGRC is also the epicenter of rust-resistance screening for five needle pines across the Pacific Northwest. Due to concerns over transmission of the disease white pine blister rust (caused by the non-native fungal pathogen *Cronartium ribicola*) between the DGRC and CRLA, propagation of Crater Lake currant (*Ribes erythrocarpum*) and waxy currant (*Ribes cereum* var. *cereum*) will be conducted by the Botany program at Park headquarters. In consideration of equipment and facility limitations at CRLA, two methods of propagation from cuttings of these species are currently in trial (documentation on file on the Botany server). An effort to propagate Crater Lake currant from seed is also being currently conducted.

Social Trail Obliteration

Based upon the initial assessment of candidate revegetation sites, fifteen sites along heavily impacted stretches of trail in the South seed zone were selected for preliminary social trail obliteration. These sites will be used to assess the effectiveness of the utilized methods and barriers, in order to guide future efforts. The sites selected for this trial were presumed to not need intensive trail work as a corrective measure, and consisted of braided trails, heavily impacted natural viewpoints, and egregious social trail viewpoints.

Soil decompaction and tread removal were conducted by hand using a McLeod or pick mattock tool (Figure 6). Where social trail use had created level shelves on hillsides, these features were recontoured to match the hillside slope (Figure 6). Following decompaction, addition of duff sourced from adjacent areas and broadcast seeding of a limited quantity of grass seed was conducted to disguise the obliterated path, amend the barren soils, and jumpstart revegetation efforts. Access to the social trails was obstructed by the addition of large, coarse woody debris and rocks (Figure 6).

Results

Project Area Assessment

The assessment of the project area identified sixty-eight revegetation sites, with a combined area totaling more than five acres. A georeferenced photo database documenting the pre-restoration conditions of the revegetation sites was created, combined with accurately mapped boundaries of the sites (located on the Botany server).

Revegetation

Native Seed Collection and Processing

A total of 12,127 g of rough-cleaned native seed was collected during the 2019 field season. A list of plant species collected from and seed collection totals are detailed in Table 2. This seed was dried and cleaned at the Park and is stored in the Botany program's seed storage freezer. This will be available for broadcast seeding and plant propagation. Additional seed collection efforts will be made during the 2020 field season.

Figure 6. Botany crew member using a McLeod to decompact a large heavily trampled area (top left). Recontouring of a social trail slope that was created too close to the caldera rim (top right). Obstruction and disguising of visitor created social trails (bottom). Photos by Carrie Wyler.

Table 2. 2019 seed collection plant species for the Rim Trail project.

2019 Seed Collection by Zone			
	Amount Collected (g) by Zone		
Species	**South**	**Central**	**North**
Achnatherum occidentalis	1,712	x	151
Aconogonon davisiae var. *davisiae*	7.5	x	10
Bromus carinatus	770	15	x
Calyptridium umbellatum	1	x	6
Carex breweri	x	26	100
Carex halliana	208	200	x
Carex inops	x	x	x
Carex pachycarpa	1,145	31	x
Elymus elymoides ssp. *elymoides*	2,677	1,569	2,000
Elymus glaucus ssp. *glaucus*	47	x	34

2019 Seed Collection by Zone			
	Amount Collected (g) by Zone		
Species	**South**	**Central**	**North**
Ericameria greenei	288	x	0
Eriogonum marifolium var. *marifolium*	175	154	484
Erigogonum pyrolifolium var. *coryphaeum*	x	32	15
Eucephalus ledophyllus	23	x	x
Lupinus andersonii	82	x	x
Lupinus lepidus var. *lobbii*	x	1	124
Phacelia hastata ssp. *compacta*	23	x	x
Phlox diffusa	7	2	7
Polygonum shastense	x	0.5	x
Total Amounts Collected by Zone	7,165.5	2,030.5	2,931
Total Collected (g)	**12,127**		

x = *plant species not collected in seed zone*

Plant Propagation

In total, 2,569 living containerized plants were propagated during the 2018 field season (Table 3). These plants experienced modest growth during the 2019 growing season at the CRLA Ball Diamond and were cared for during the field season (Figure 7). Over the fall and winter of 2019/2020 4,746 plants are being propagated by the DGRC (Table 4).

Table 3. Plants propagated at Park headquarters in 2018 for the Rim Trail project.

Live Plants in Inventory as of Fall 2019	
Scientific Name	Number of Plants*
Bromus carinatus	488
Achnatherum occidentalis	392
Ericameria greenei	611
Elymus elymoides ssp. *elymoides*	588
Phlox diffusa	196
Eucephalus ledophyllus	294
Total	**2,569**

**All seed used in plant propagation efforts sourced from the South seed zone.*

Figure 7. Shadehouse where plants are housed and cared for during the field season (left). Botany crew member conducting plant care (right). Photos by Carrie Wyler.

Table 4. List of plants being propagated for the 2020 season.

Rim Trail Propagation Fall 2019		
Seed Collection Zone	**Scientific Name**	**Number of Plants**
South Rim Trail	*Ribes erythrocarpum*	198
	Elymus glaucus ssp. *glaucus*	98
	Achnatherum occidentalis	300
	Aconogonon davisiae var. *davisiae*	400
	Arctostaphylos nevadensis	250
	Carex inops	400
	Ericameria greenei	400
	Eucephalus ledophyllus	200
	Holodiscus microphyllus	100
	Lupinus andersonii	300
	Phlox diffusa	200
	Total	2,846
Central Rim Trail	*Aconogonon davisiae* var. *davisiae*	300
	Arnica viscosa	200
	Ericameria greenei	300
	Phlox diffusa	300
	Total	1,100
North Rim Trail	*Carex breweri*	400

Rim Trail Propagation Fall 2019		
Seed Collection Zone	**Scientific Name**	**Number of Plants**
	Ericameria greenei	400
	Polygonum shastense	15
	Total	800
Total		**4,746**

Social Trail Obliteration

Preliminary social trail obliteration was conducted at fifteen revegetation sites, encompassing approximately 0.7 acres of area in total (Figure 9). Approximately 1,530 g of bottlebrush squirreltail seed (*Elymus elymoides* ssp. *elymoides*) was broadcast seeded in these areas. Figure 8 demonstrates before and after pictures of two obliterated social trail sites.

Figure 8. Before (left) and after (right) results of social trail obliteration work at two revegetation sites. Photos by Carrie Wyler.

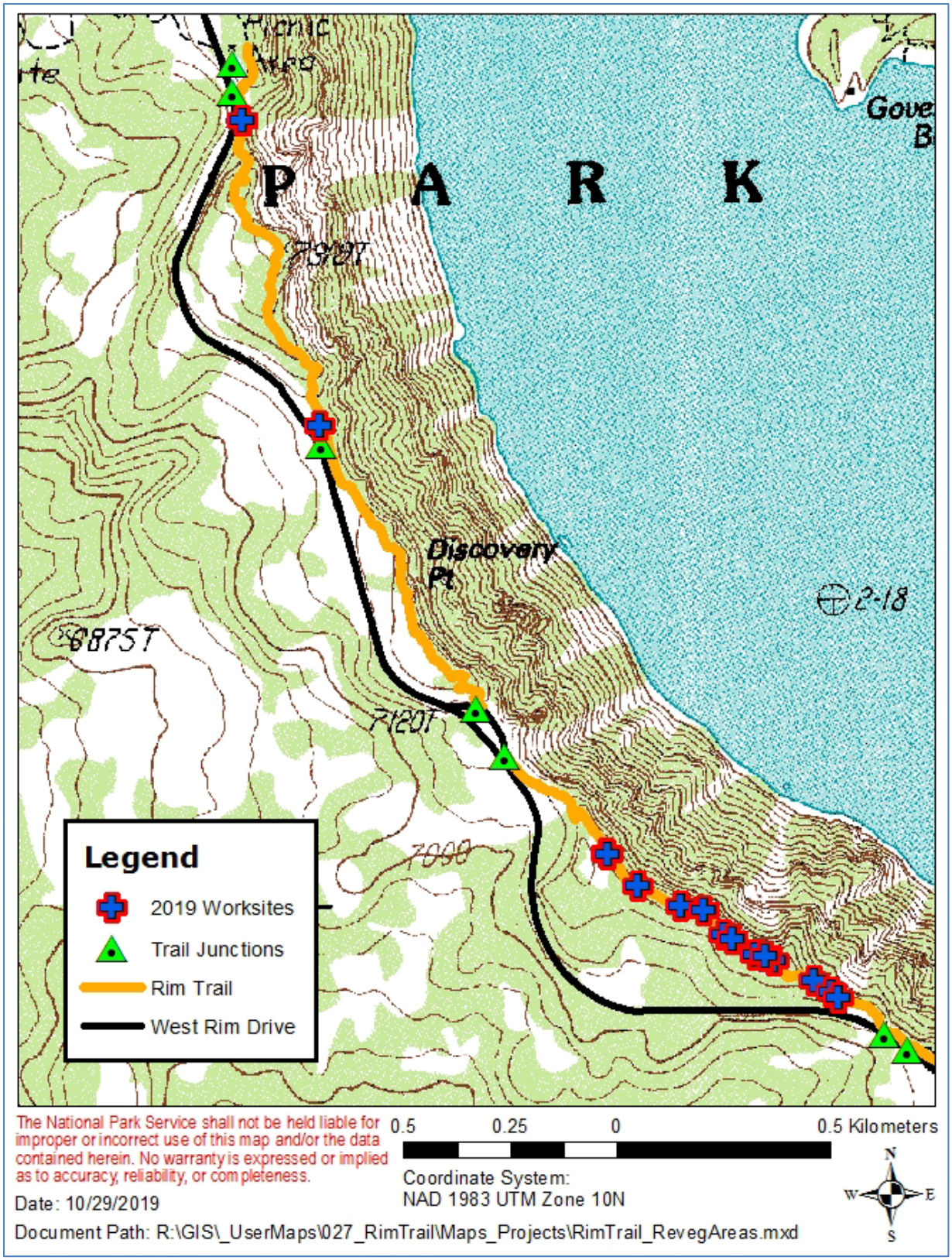

Figure 9. The fifteen 2019 Rim Trail project revegetation sites (out of 68 total sites). Map by Scott Heisler.

Discussion

The density of severely impacted areas along the Rim Trail strongly correlates to the number of nearby developed access points, and likely corresponds to increased levels of casual visitation for purposes other than hiking (seeking views of the lake, picnicking, photography, etc.). To address visitors not interested in following an established trail, more formalized barriers and guidance may be needed to restrict access to natural areas proximal to the trail corridor. Careful consideration should be given to development and implementation of trail traffic control measures, as to not significantly impact the viewshed or redirect traffic into undisturbed locations. Monitoring the 2019 social trail obliteration sites will hopefully provide some guidance on the efficacy of passive, native material use methods of obstructing access in these high-use areas.

Certain sections of the Rim Trail have developed excessively wide tread which likely arose from a lack of clear trail delineation, an issue which is further exacerbated by expanses of barren pumice meadows resulting from trampling of trailside vegetation (Figure 9). These areas are common in the wind scoured pumice fellfield terrain at the northern end of the trail. To address this issue while maintaining the unique and spectacular viewshed afforded by these open expanses, it is suggested to conduct a trial of delineating the trail with stone edging combined with educational signage at access points. This method is currently in use on limited sections of the Rim Trail converted from the old Army Corps of Engineers Rim Road grade, and effectively confines most traffic to a narrow passage along the wide historic road grade (Figure 10). A trial would help assess the efficacy and aesthetics of this method in a natural (e.g., not an old roadbed) area. Implementation of this technique would need to be conducted by the CRLA Trails program.

Figure 10. Large barren trampled fellfield terrain area containing the poorly defined Rim Trail (left). Example of an area that implements rocks to delineate the trail for a clear path (right) along the old Rim Road grade. Photos by Jen Hooke.

The Rim Trail is situated in a location of the Park (close by Rim Village and West Rim Drive) that is readily accessible in late spring and early summer, a time when large areas of the Park have limited access due to the prior winter's lingering snowpack. This results in high levels of traffic on the trail at a time when snowmelt is variable and the snowpack obscures portions of the trail. Visitors

attempting to follow the trail during this confusing period of lingering snowpack are prone to creating unintentional social trails. These social trails often continue to be followed after the snow melts and the vegetation is in a particularly vulnerable stage as it is emerging from winter dormancy. To address this source of social trail creation, temporary trail signage should be considered. This signage could take the form of a limited quantity of plastic flagging in problem areas, or carsonite signs marking the trail. If ground-based signs are used, locations would need to be selected that wouldn't require frequent re-setting as the snowpack melts.

This project has one more year of available funding, which should be received in 2021 or later when the Trails program has had the opportunity to complete cyclic rehabilitation work on the entire stretch of trail. Additional funding will be sought to continue revegetation work on this project in future years. Consultation and coordination with the Trails Supervisor will be an essential part of ensuring this collaborative rehabilitation project is successful. The site assessments and revegetation site index will be shared with the Trails Supervisor, so he is aware of the extent of revegetation needs existing along the trail corridor. A close partnership between the Trails and Botany programs will ensure that rehabilitation needs are addressed and remedied.

Additional native seed collection is planned for the 2021 field season. Once the landscape repairs have been completed, all revegetation sites will be planted and seeded as per site prescriptions and available plant materials. Especially problematic areas may need additional barriers such as low fences and/or signs to encourage hikers to remain on trail corridors (Figure 11).

Figure 11. Low, easily movable, barrier fencing (left). Photo by Carrie Wyler. Carsonite sign directing visitors to the trail location (right). Photo by Scott Heisler.

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April 2020

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