



Invasive Vegetation Management

2016 Annual Report



**ON THIS PAGE**

Invasive Vegetation Management crew members surveying recently burned areas for new infestations of invasive plant species.

Photo by Renee Gallardo.

ON THE COVER

Invasive Vegetation Management crew members removing invasive plants along the shore of Crater Lake.

Photo by Sarah Hall.

Invasive Vegetation Management

2016 Annual Report

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Abstract

Work performed by the Crater Lake National Park Invasive Vegetation Management program during the 2016 season continued its focus on detecting, containing, and reducing populations of invasive plant species within the Park. Steady progress made in 2016 and in previous years has helped stave off invasion of the Park's native plant communities by non-native plant species. In 2016, invasive plants were controlled Park-wide using manual treatment methods. Approximately 105,318 invasive plants were controlled in 2016; eight new weedy species were encountered within the Park. Large construction projects and natural events occurring within the Park this season presented challenges to the Invasive Vegetation Management program and will continue to need attention in the coming years; this includes the Rim Drive Rehabilitation project and the Bybee Creek wildfire. Recommendations are made for the 2017 Invasive Vegetation Management field season and beyond.

Acknowledgments

The 2016 Invasive Vegetation Management seasonal crew at Crater Lake National Park was made possible through support provided by the U.S. Department of the Interior/National Park Service Burned Area Rehabilitation program, the Federal Highways Administration – Western Federal Lands Highway Division, the National Park Service Recreation Fee program, and the Crater Lake Fire Management program. The Biological Resource Division of the National Park Service Natural Resource Stewardship and Science program provided funds for Invasive Vegetation Management field equipment and supplies. Invasive plant observations reported by other Crater Lake National Park employees, especially the Revegetation, Bull Trout, and Roads staffs, were greatly appreciated and very helpful in preventing the spread of invasive plants. Sean Mohren developed the new Invasive Vegetation Management Access database, and Chris Wayne supported data collection efforts through development and maintenance of a geodatabase and Trimble Juno units.

Introduction

The 2016 season marked the fourteenth year of recurring management of non-native, invasive plant species within Crater Lake National Park (CRLA). Invasive species are widely recognized as being one of the largest threats to natural areas; as such, the National Park Service (NPS) has been charged with preventing the introduction of non-native, invasive plant species and controlling infestations of invasive plants where they have become established (USDI NPS 2006). Responding quickly to new invasions and controlling existing infestations of invasive plants are important functions of CRLA's Invasive Vegetation Management (IVM) program.

The goals of the IVM program are:

1. *Prevention*: prevent the introduction and spread of invasive plant species within Crater Lake National Park.
2. *Early Detection and Rapid Response*: survey for new invasive plant infestations to allow for swift treatment and control.
3. *Effective Control*: control invasive plant species within the Park through eradication, containment, and reduction of invasive plant population densities and abundance. Utilize an adaptive management framework based on the best available science and current knowledge to determine the most effective and appropriate treatment options for proactively controlling invasive plant species.
4. *Monitoring and Data Management*: monitor treatment efficacy, and use results of monitoring to inform management. Manage invasive vegetation data to enable regular reporting of results and progress.
5. *Outreach and Education*: educate and inform the Park's visitors, employees, and partners on the Park's Invasive Vegetation Management program and involve them in prevention, control, and monitoring efforts.
6. *Collaboration*: communicate regularly with Park partners, including other federal, state, and county entities, and collaborate on invasive vegetation management and control.

The IVM program was fortunate in 2016 to have seven devoted seasonal Biological Science Technicians, which was the largest crew in the IVM program's history. This was made possible through support from the Department of Interior (DOI) NPS Burned Area Rehabilitation (BAR) program, Federal Highways – Western Federal Lands Highway Division (WFLHD), the NPS Recreation Fee program, and the Crater Lake Fire Management program. The NPS Recreation Fee program provided funding for treatment of invasive plant species in high visitor use areas such as visitor centers, campgrounds, and picnic areas along with popular trails, backcountry camps, and scenic overlooks (Figure 1). The Federal Highways WFLHD program provided funding for invasive plant survey and control along roads affected by the 2014 Pavement Preservation project. The Pavement Preservation project applied a chip-seal treatment to most Park roads (Highway 62,



Figure 1. Removing invasive plants from a subalpine meadow by the Crater Lake Lodge. Photo by Carrie Wyler.

Munson Valley Road, headquarters/housing service roads, Pinnacles Road, Cloudcap Spur Road, and North Entrance Road) and utilized numerous staging areas (Pumice Desert Overlook, South Yard, Ball Diamond, junction of East Rim Drive and Pinnacles Road, Pole Bridge Creek Quarry, and the junction of North Entrance Road with West Rim Drive). Unfortunately, a contaminated (e.g., not weed-free) gravel source was used during project implementation, so funds were provided to the Park for follow-up treatment and effectiveness monitoring. The majority

of CRLA's invasive plants are found within these "front-country" areas; however, an increasing number of invasive plant populations are being discovered in the Park's backcountry, including remote stretches of recommended wilderness. The Park is planning for implementation of the West Panhandle Forest Restoration project, which will utilize silvicultural treatments to restore forest structure, composition, and function in ponderosa pine (*Pinus ponderosa*) dominated forests in the southern portion of the Park. Funding was received from the CRLA Fire Management program to survey for and control invasive plants within the project area. This is intended to help lessen project impacts upon the Park's native plant communities that are the focus of restoration efforts.

Funding was also received from the DOI NPS BAR program to survey for and control invasive plants within the areas impacted by the 2015 National Creek Complex and 2014 Pumice Complex of wildfires. The Crescent fire of the National Creek Complex was the largest fire in the Park's recorded history affecting 14,639 acres within the Park. The National Creek Complex burned nearly 21,000 acres, including neighboring lands on the Rogue River Siskiyou and Umpqua National Forests. Throughout the course of the incident, thousands of fire management personnel were brought in to assist with control and suppression costs totaled \$22,000,000. The Pumice Complex included 40 lightning-ignited wildfires that were aggressively suppressed; the largest of which was the 25-acre Pumice fire. Over 300 firefighters were brought in to manage the fires and suppression costs exceeded \$2,000,000. In addition to burned areas, other impacted areas such as base camps, spike camps, helispots, social trails, etc. were subject to invasive plant survey and treatment efforts.

The IVM program continues to evolve and to improve techniques for protecting the Park's native plant communities through expanded survey and control efforts, strengthened prevention techniques, and better data management and reporting systems. The large 2016 IVM field crew enabled a substantial increase in invasive plant survey and treatment efforts. A new IVM Access database was utilized in 2016 with data collection accomplished using Trimble Juno handheld computers with GPS receivers (Figure 2). The Park has completed a draft Invasive Vegetation Management Plan Environmental Assessment that will hopefully be finalized in 2017 (DOI NPS 2017). This includes

an expanded array of treatment options with hopes to greatly expand and enhance prevention, control, and management options Park-wide.

Major activities that occurred within the Park in 2016 with repercussions for invasive vegetation management include the Rim Drive Rehabilitation project, a multi-year effort that continued this year and caused substantial ground disturbance to areas of West Rim Drive from the Union Peak Overlook to North Junction. This major road construction project involved large amounts of construction and contractor traffic with much heavy equipment brought into the Park. Another significant event was the Bybee Creek wildfire, which burned 1,072 acres within the Park. This fire was managed under a full suppression strategy, involving almost 400 firefighting personnel and much aviation support that delivered over 61,000 gallons of fire retardant to the Park's backcountry forest and meadow environments (Figure 3). Finally, 2016 marked the centennial anniversary of the inception of the National Park Service. An effective national "Find Your Park" campaign was launched to encourage visitation to NPS units. Crater Lake National Park saw record-breaking visitation with over 756,000 visitors in 2016 compared to approximately 500,000 visitors received in an average year.



Figure 2. IVM crew members documenting invasive plant occurrence and control using a Trimble Juno unit. Photo by Liv Bly.



Figure 3. Fire retardant drop affecting pumice meadow and subalpine forest vegetation during suppression of the 2016 Bybee Creek fire. Photos by Jen Beck.

Invasive plant species are affected by annual fluctuations in precipitation and temperature, as these factors influence growing season length among other things. An increase in growing season length may benefit invasive plant species, as these species often have short life cycles and high rates of fecundity (Bradley et al. 2010). The 2016 season marked a turning point from the three consecutive summers the Park and region suffered through a drought to an “abnormally dry” season on the drought scale according to the National Integrated Drought Information System (NIDIS). The Park received 461” of snowfall at Park headquarters (average is 524”) during the 2015 –2016 water year (October 1 – September 30), which is 90% of average. However, the total amount of precipitation (melted) received at Park headquarters was above average at 74” (average is 67”), which is 111% of average. Snowmelt occurred near the average time with the first snow-free date at Park headquarters reached on June 8th (average date is June 20th). These factors may have helped stabilize invasive plant population sizes in 2016.

Methods

Crater Lake National Park has assigned all of its non-native plant species a management priority of low, medium, high, or watch. All high priority species are actively targeted for control efforts; medium priority species are targeted as time and resources allow. Low priority species are usually not targeted for management, either because populations of those species are not aggressively spreading or populations are beyond control. Watch species are those that have been documented within the Park, but have not been observed in some time (> 10 years) or species that are found outside but proximal to the Park. If any watch species are found within the Park, they will receive a management priority of high. These management priorities may change depending upon situation and location. For example, a low priority species may be controlled if found in a pristine wilderness environment and its control is feasible. A high priority species may not be treated in a specific region where its population is beyond control. Low priority species may be controlled concurrently at sites where high priority species are being treated.

The Park has been divided into IVM Regions where survey and control efforts are targeted. Each region is a “problem area” where invasive plants are known to be concentrated or have recently been detected. The control strategy for each region varies depending upon which species it contains. General control strategies for invasive plant species are *containment* – preventing new infestations and spread; *reduction* – reducing the size and extent of existing infestations; and *eradication* – extirpating the invasive plant species from the Park. Prior to the field season, IVM data are queried by region and maps of invasive plant species distribution created. Packets are made for the IVM crew containing the following information per region: maps of the region in relation to the Park, including directions on best access to the site (if applicable); spatial data on which species are found in each region provided on maps and also digitally for import to a Trimble or Garmin GPS unit; and

abundance (number) and size of each invasive plant population per spatial coordinate set.



Figure 5. IVM crew members surveying for invasive plants in a grid pattern. Photo by Sarah Hall.

Invasive vegetation survey consists of visually searching a region, typically on foot but sometimes via boat, automobile, or bicycle, for invasive plant species. The IVM crew navigates to known invasive plant locations with a GPS unit and searches a broad grid (Figure 5) around that coordinate point using transects (width determined by terrain and vegetation structure). In previously un-surveyed areas with no record of invasive plant species, surveys are concentrated on the most

likely establishment points such as open habitats, areas with moist soils or close to water, and recently disturbed habitats. It is unlikely to find invasive plant species in dense, closed canopy forests at CRLA.

Presently, control of invasive plant species at CRLA is largely limited to manual methods. Most invasive plants are pulled or severed from the root below the ground surface using a digging knife.

Once an invasive plant population is discovered, data are recorded including scientific name, UTM coordinates (Zone 10, NAD83 datum), total number of plants present, area (m²) that plants occupy, and treatment applied to population. Data are input into a Trimble Juno field computer and GPS receiver using ArcPad software. All plant parts capable of reproduction (e.g., inflorescences in the case of plants that reproduce via seed and rhizomes/corms/tubers for plants capable of vegetative reproduction) are bagged, removed from the site, and disposed of in the trash compactor at Park headquarters where they are hauled (in a closed truck) to the Dry Creek Landfill in White City, Oregon for burial. Vegetative parts incapable of reproduction are left to desiccate on site unless they present logistical or aesthetic problems for Park visitors, employees, and partners.

When possible, any new-to-CRLA non-native plant species encountered are collected as voucher specimens for the Park's herbarium. Often only one or two individuals are discovered and are destroyed during the plant identification process, so vouchers are missing in these cases. Non-native plants encountered in previously undocumented locations within the Park are also collected for the Park's herbarium.

If plant specimens found during surveys are not identified in the field (Figure 6), they are taken back to the office for identification. When possible, two samples are collected – one to use for identification and one to serve as a voucher for the Park herbarium (in cases where the plant deserves documentation). The population location is mapped with a GPS unit and species is listed as 'Unknown;' a unique code is assigned to the plant. The plant is identified immediately before desiccation or decomposition occurs and pressed along with pertinent information. Plants that cannot be identified the same day are placed in the specimen refrigerator in the office. Once the plant is identified the species name is changed from 'Unknown' to the correct species code in ArcPad or the IVM database.



Figure 6. IVM crew members identifying unknown plants in the field with the native leather grapefern (*Sceptridium multifidum*) in the

Results

Invasive vegetation survey and control work occurred from May 16 – September 29, 2016. A total of 105,294 invasive plants were treated during the 2016 season, including 8 new weedy species that had not been previously recorded within CRLA: sweet vernalgrass (*Anthoxanthum odoratum*), tall oatgrass (*Arrhenatherum elatius* ssp. *elatius*), canola (*Brassica napus*), horseweed (*Conyza canadensis*), flixweed (*Descurainia sophia*), cutleaf evening primrose (*Oenothera laciniata*), dog rose (*Rosa canina*), and tansy ragwort (*Senecio jacobaea*). All but one of these new species was found along Park roadsides; tansy ragwort was found within the perimeter of the Crescent fire. These finds bring the number of non-native plant species documented within CRLA to 85.

The 2016 season also brought an increase in weedy native species that have been noticeably expanding their range within the Park including pineapple weed (*Matricaria discoidea* – first discovered in the Park in 2014) and Pursh's lotus (*Acmispon americanus* var. *americanus*). Additional populations of pineapple weed were encountered at Rim Village (the original introduction point) along with new populations discovered at Mazama Village and along Upper Munson Valley Road. Pursh's lotus is adventive and in previous years this species was mostly located along the lower elevations of west and south Highway 62. In 2016, it was observed to occur abundantly along Munson Valley Road, at Park Headquarters, and was found dominating a landscaping bed at Rim Village in front of the Crater Lake Lodge.

It is difficult to make year-to-year comparisons of IVM findings due to differences in crew size (e.g., one person in 2013 vs. seven people in 2016) and therefore survey and control efforts; constraints on work dictated by funding sources that vary each year (e.g., receiving funds to only work along roadsides and in developed areas); different control priorities (e.g., in some years with large workloads lower priority species are triaged); the fact that some invasive plant species are missed or not surveyed in any given year (resulting in false low numbers); and also different invasive plant survey priorities in each year. For example, IVM work in 2013 focused on surveying areas with known invasive plant populations and very little new territory was surveyed. In 2014-2016, surveys have also been conducted in areas with no previously known invasive plant infestations such as recently burned areas. Much survey time is spent finding invasive plants while also traversing areas containing no non-native plants.

Control efforts put forth by the 2016 IVM program are presented by general regions including roadsides, staging areas, developed areas, backcountry areas, and the shore of Crater Lake. Data displayed on the following maps indicate the number of invasive plants found and treated during the 2016 season.

Park Roadsides

Roads within the Park include Highway 62, Munson Valley Road, West and East Rim Drives, Pinnacles Road, Grayback Road (closed to public motor vehicle traffic), North Entrance Road, and Highway 138. Of these, only Grayback Road has been found to be free of invasive plant species. The greatest concentrations of invasive plants in the Park are found along roadsides, as roads serve as conduits for invasive plant introduction and their constant maintenance creates ground disturbance



Figure 7. Roadside maintenance in a rockfall-prone area along East Rim Drive exposes mineral soil, facilitating invasive plant introduction and spread. Photo by Jen Beck.

that exacerbates their establishment and spread (Figure 7). Highway 62 contains the largest and most abundant infestations of invasive plant species (especially South Highway 62 closest to the south entrance), with Highway 138 and Munson Valley Road also supporting considerable infestations. West and East Rim Drives contain localized infestations of invasive plant species; portions of these roads have been found to be weed-free. North Entrance Road is sparsely colonized by invasive plants; very few infestations have been found along this road and most have been associated with the North Entrance Station infrastructure and the junction with Highway 138, or the Pumice Desert pullout. Roadside invasive plant locations encountered in 2016 are displayed in Figure 8. Comparisons with findings from the 2014 and 2015 field seasons are made in Table 1.

Invasive plant survey and control work for West and East Rim Drives continued to be funded in 2016 by the Federal Highway Administration's

Rim Drive Rehabilitation project; this work is discussed further in the 2016 Rim Drive Rehabilitation Revegetation annual report. Steady progress was made toward controlling persistent invasive plant populations at Rim Village, which is the area that receives the highest level of visitor use.

Table 1. Number of roadside invasive plant species removed in the 2014, 2015, and 2016 field seasons by park road and by invasive plant species.

Park Road	2016	2015	2014
East Rim Drive	792	287	1,251
Highway 138	8,292	3,727	6,042
Munson Valley Road	4,492	25,897	19,492
North Entrance Road	126	337	35
Pinnacles Road	30	0	0
South Highway 62	12,471	12,847	15,840
West Highway 62	3,708	3,805	2,810
West Rim Drive	1,653	1,827	2,264
Total	31,564	48,727	47,734
Plant Species	2016	2015	2014
Smooth brome	2,336	2,537	1,364
Cheat grass	1,933	2,217	315
Spotted knapweed	58	517	102
Rush skeletonweed	3	3	14

Species	2016	2015	2014
Canada thistle	0	8	3
Bull thistle	33	8	0
Jerusalem oak	1,110	21,454	15,700
St. John's wort	1,715	4,668	796
Bulbous bluegrass	2,340	3,900	6,422
Sheep sorrel	15,158	4,317	18,601
Dandelion	2,247	3,135	1,785
Yellow salsify	69	165	24
Mullein	19	96	28

Cheat grass (*Bromus tectorum*) continues to populate roadsides throughout the Park including Highway 138, Highway 62, and East Rim Drive with the largest population occurring near the Old South pullout on south Highway 62. Spotted knapweed (*Centaurea stoebe* ssp. *micranthos*) occurrences decreased in number since last year with most populations occurring along the northern Park boundary along Highway 138 as well as one population on south Highway 62. Two populations of Jerusalem oak (*Dysphania botrys*) believed to be introduced after implementation of the 2014 Pavement Preservation project experienced a reduction in population size from last season. No known seed has been released from these sites, and it is hoped that the seed bank will be exhausted with annual control efforts. The Pumice Desert Overlook continued to support populations of field bindweed (*Convolvulus arvensis*) and purple anther field pepperweed (*Lepidium heterophyllum*) that were first discovered in 2015 and the first known non-native plant species to impact the Pumice Desert Research Natural Area.

Seven new-to-the-Park weedy plant species were documented along Park roadsides in 2016. Tall oat grass was found growing out of a pavement crack on Lower Munson Valley Road. Flixweed and wild cabbage were found on East Rim Drive within the area affected by the 2014 Rockfall Mitigation project. Sweet vernal grass was found along the entrance road to the Mazama Campground, which was recently repaved and subjected to a 'shoulder backing' treatment where aggregate/earthen mix material was added to the road shoulders to protect the pavement edge from crumbling. Horsetweed was found at the south entrance along Highway 62 where it has been spreading into the park from the highway and the Annie Creek Sno-Park. Cutleaf evening primrose was found next to the generator building at Park headquarters. Dog rose (Figure 9) was found along west Highway 62 growing along the road shoulder. These new populations will be surveyed and treated next season.

Crater Lake National Park

2016 IVM Roadsides

National Park Service
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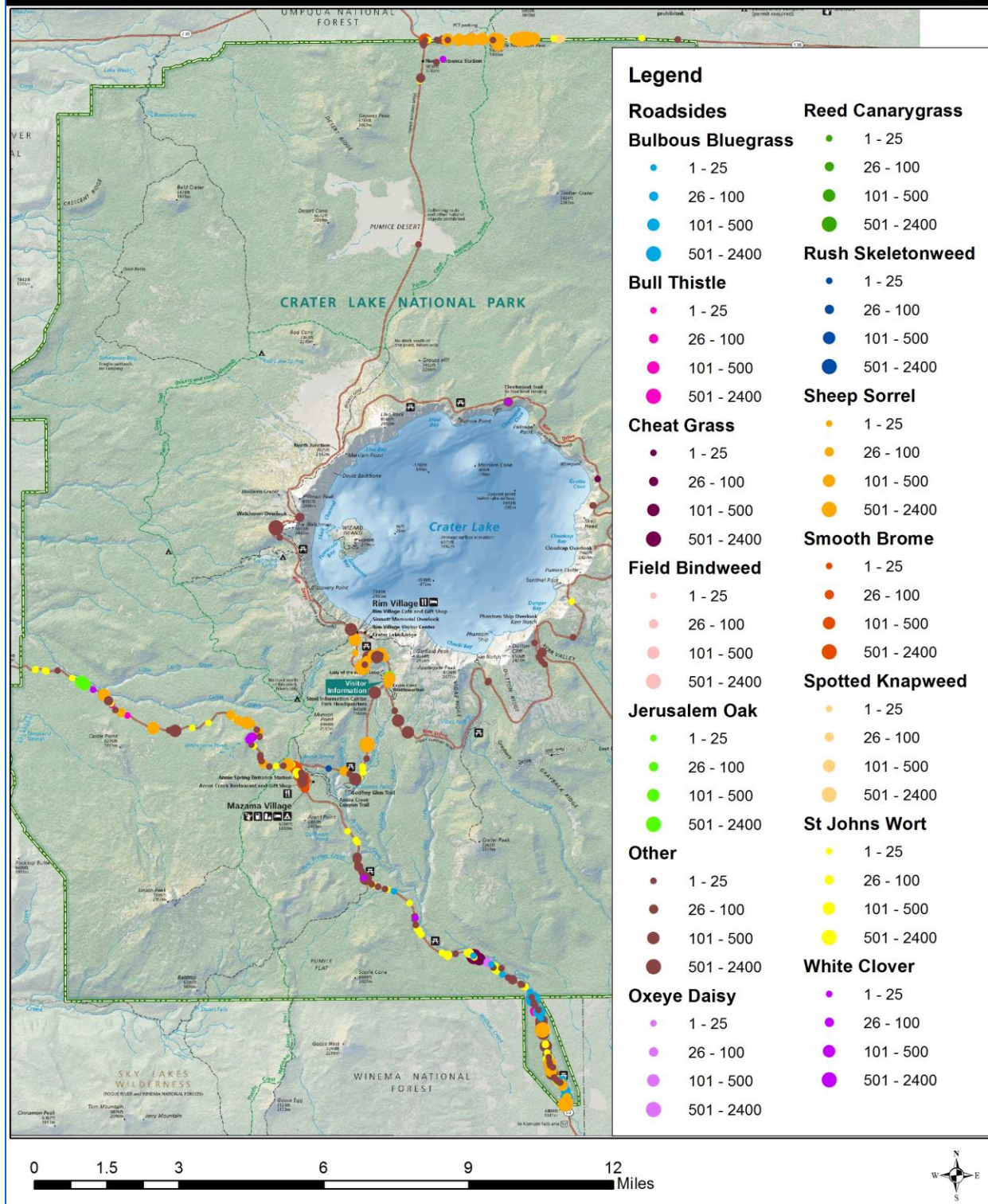


Figure 8. Invasive plants controlled along Park roadsides by the IVM program in 2016. Map by Jen Beck.

Staging Areas

The Park's staging areas include large yards and old quarries that are closed to the public and used for staging of materials, vehicles, and equipment. These include South Yard, Pole Bridge Creek Quarry, the Ball Diamond, Anderson Quarry, and Roundtop Quarry. Invasive plants encountered in 2016 at Park staging areas are displayed in Figure 11. Comparisons with findings from the 2014 and 2015 field seasons are made in Table 2.

The South Yard has persistent populations of wooly mullein (*Verbascum thapsus*), St. John's wort, and sweet clover (*Melilotus* sp.). Pole Bridge Creek quarry experienced a decrease in yellow rocket (*Barbarea vulgaris*) this year, and following a reported decrease in St. John's wort in 2015 (eight plants) only two plants were found this year. Anderson Quarry had an increase in yellow rocket, with approximately triple the amount of plants found this year compared with 2015. There have been no invasive plants found at the Ball Diamond or Roundtop Quarry. Roundtop Quarry experienced massive ground disturbance in 2015 and 2016 from the Rim Drive Rehabilitation project (Figure 10); this area will need to be surveyed continually for invasive plant establishment and subjected to intense revegetation and restoration efforts.



Figure 10. Roundtop Quarry continues to be the most highly impacted staging area in the Park. Photo by Jen Beck.

The 2014 Pavement Preservation project utilized several park staging areas and additional areas to stockpile gravel and equipment used during project implementation. Affected areas include: South Yard, Pole Bridge Creek Quarry, Roundtop Quarry, the Ball Diamond, the North Junction parking area, the Pumice Desert Overlook, and the junction of East Rim Drive and Pinnacles Road. These sites continue to need monitoring for invasive plant establishment and spread.

The upper Pole Bridge Creek Quarry continued to be used as a helispot, with Pole Bridge Creek sourced for water to support fire management operations. These sites should be monitored for invasive plant establishment. While not used as a staging area, the Watchman Flow on West Rim Drive is actively used by the Trails program for masonry materials. This area has been found to be free of invasive plant species, but is monitored each year for new invasive plant establishment.

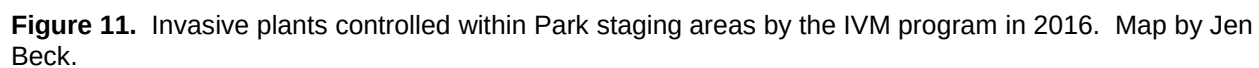


Table 2. Number of staging area invasive plant species removed in the 2014, 2015, and 2016 field seasons by staging area and by invasive plant species.

Staging Area	2016	2015	2014
Anderson Quarry	73	25	259
Ball Diamond	0	0	0
Pole Bridge Creek Quarry	239	780	44
Roundtop Quarry	0	0	0
South Yard	16	1,255	313
Watchman Quarry	0	0	0
Total	2,344	4,075	2,635
Plant Species	2016	2015	2014
Yellow Rocket	300	700	259
St. John's wort	5	6	3
Dandelion	4	1	307
Mullein	13	10	11

Regular and recurring survey and control of invasive plants within Park staging areas helps keep established invasive plant populations contained. Marking the boundaries of invasive plant populations (including a buffer zone to include areas of seed dispersal) with pin flags and noxious weed flagging, and communicating these locations to Park Maintenance staff help prevent the spread of contaminated earthen materials around the Park.

Developed Areas

The Park's developed areas include Park headquarters (visitor center, administrative buildings, parking areas, Sleepy Hollow housing loop, Steel Circle housing loop, the Stone Houses, and the Science and Learning Center); Rim Village (including the Crater Lake Lodge, Picnic Hill, promenade, and Rim Dorms); the Park's two campgrounds (Mazama Campground – including the Xanterra employee loop, and Lost Creek Campground); Mazama Village (including the camper store, Annie Creek Restaurant, and Mazama Cabins); Mazama Dorms; and two sewage lagoons (Mazama Dorms and Steel Circle). Invasive plants encountered within the Park's developed areas in 2016 are displayed in Figure 13. Comparisons with findings from the 2014 and 2015 field seasons are made in Table 3.

These developed areas are surveyed at least twice per growing season (Figure 12). Problem areas are visited more frequently, depending on the situation. The Steel Circle sewage lagoons are free of invasive plants, but all other developed areas support a wide variety of non-native plants. The most heavily infested areas are Park headquarters and Rim Village.



Figure 12. IVM crew members survey the Mazama sewage ponds for invasive plant species. Photo by Sarah Hall.

The Rim Village parking lot was recently renovated; this area will need to be watched in 2017 for invasive plant establishment. The Mazama Campground (all loops and access roads) was repaved in 2014; this area should also be monitored for invasive plant establishment. All roads around park Headquarters were also affected by the 2014 Pavement Preservation project and “chip seal” treatment, so future invasive plant surveys should keep that in mind.

Table 3. Number of developed area invasive plant species removed in the 2014, 2015, and 2016 field seasons by developed area and by invasive plant species.

Developed Area	2016	2015	2014
Headquarters/Housing	18,815	16,181	491
Lost Creek Campground	45	7	*
Mazama Campground	56	*	*
Mazama Dorms	4	*	*
Mazama Village	2,926	36	6
Rim Village	27,496	30,630	14,419
Total	49,342	46,854	14,916
Plant Species	2016	2015	2014
Yellow Rocket	554	456	1,084
Smooth brome	2,628	*	*
St. John's wort	125	16	15
Sheep sorrel	15,846	5,408	4,557
Dandelion	2,857	834	1,183
White clover	1,333	533	633

*Not surveyed or treated

Crater Lake National Park

2016 IVM Developed Areas

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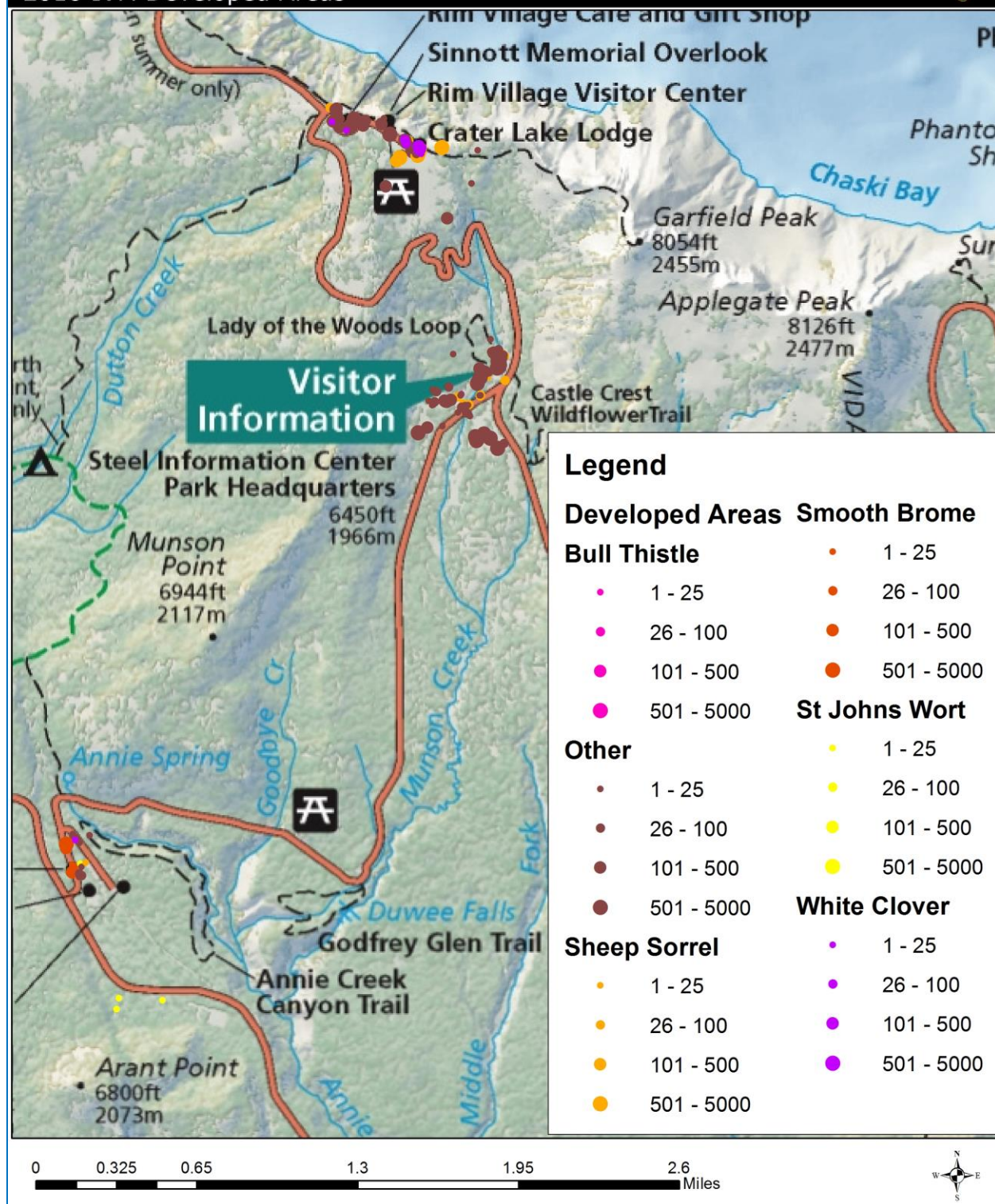


Figure 13. Invasive plants controlled within Park developed areas by the IVM program in 2016. Map by Jen Beck.

Backcountry Areas

The Park's backcountry areas include areas burned by wildfire (Red Blanket Canyon, 2015 Crescent fire, 2014 Pumice Complex of fires, 2008 Castle Fire, 2006 Bybee fire); Spruce Lake; Panhandle sites (Cottonwood Meadows, Interior); prescribed burn units (PH3, Upper Panhandle, Cornerstone); riparian areas (Annie Creek, Bybee Creek, Castle Creek, Crater Creek, Pothole Creek, Sand Creek, Sun Creek); and meadow systems (Castle Creek meadows, Poison Meadows). Backcountry areas that were not surveyed during the 2016 season include the 2006 Bybee fire and Munson Creek. Invasive plants encountered in backcountry areas during the 2016 season are displayed in Figure 15. Comparisons with findings from the 2014 and 2015 field seasons are made in Table 4.

New invasive plant infestations were discovered in 2016 within the Crescent fire (Figure 14) of the 2015 National Creek Complex consisting of mostly Canada thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*) populations. One new-to-the-Park invasive plant species, tansy ragwort (*Senecio jacobaea*), was discovered in this area. The level of invasion found in this area is not surprising due to fire intensity and the large scale of fire suppression efforts. The Red Blanket Canyon continued to present a formidable challenge to the IVM crew in many respects. Dense snag patches, steep slopes, poor access, and large invasive plant populations continue to slow invasive plant control efforts in this area.

Areas affected by the 2016 Bybee Creek fire will be added to the list of backcountry high priorities for 2017 IVM survey and control efforts. Areas directly impacted by fire suppression activities such as firelines, retardant drops, medevac sites, spike camps, and staging areas plus areas that burned with moderate to high severity in both 2016 and 2006 will be targeted. Additionally, surveying backcountry sites with high biodiversity or biological significance (e.g., meadows, rare plant populations, Research Natural Areas) will be a priority for the 2017 IVM crew.



Figure 14. The IVM crew surveying area burned by the 2015 Crescent Fire. Photo by Sarah Hall.

Crater Lake National Park

2016 IVM Backcountry

National Park Service
U.S. Department of the Interior

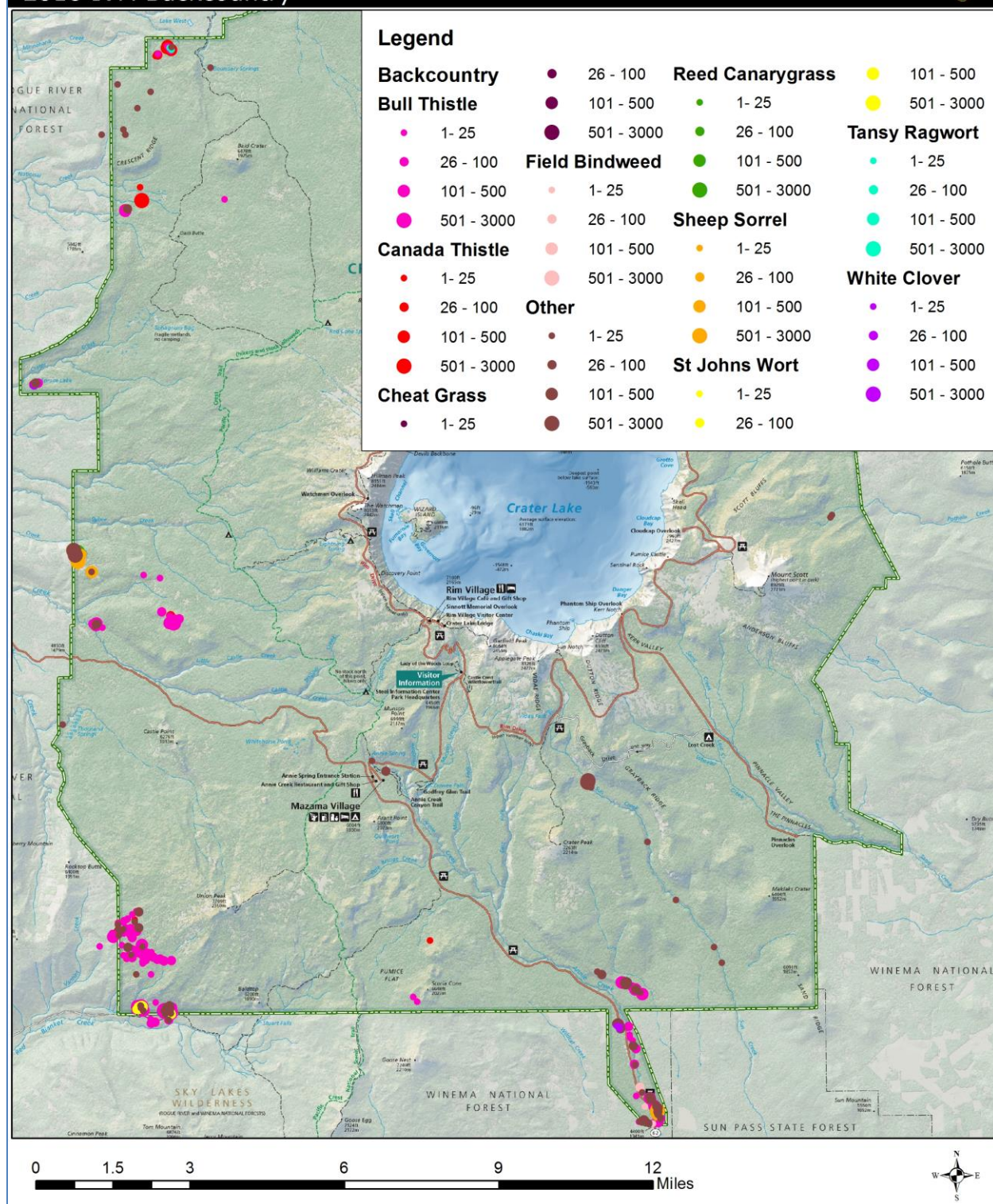


Figure 15. Invasive plants controlled within Park backcountry areas by the IVM program in 2016. Map by Jen Beck.

Table 4. Number of backcountry invasive plant species removed in the 2014, 2015, and 2016 field seasons by backcountry area and by invasive plant species.

Backcountry Area	2016	2015	2014
Annie Creek	3,718	5,923	*
Bybee Creek – Lower	*	44	*
Castle Creek – Lower	972	1,373	1,230
Castle Creek – North Fork	261	584	1,049
Castle Fire	1,442	5,189	1,014
Cornerstone Burn Unit	*	*	23
Crater Creek – Lower	*	3,083	389
National Creek Complex	3,084	*	*
Panhandle - Interior	205	324	180
Panhandle – Cottonwood Meadow	469	1,591	1,923
Poison Meadows	6,362	4,766	1,156
Pothole Creek	46	500	197
Pumice Complex	6	0	*
Red Blanket Canyon	8,965	16,448	2,067
Sand Creek	*	386	*
Spruce Lake	249	2,276	905
Sun Creek	2,702	2,457	471
Thousand Springs	3	*	1,295
Upper Panhandle Burn Unit	1,116	16,467	*
Total	29,600	61,411	11,899
Plant Species	2016	2015	2014
Cheat grass	105	161	0
Canada thistle	2,942	757	5,759**
Bull thistle	13,166	34,899	**
St. John's wort	592	701	465
Reed canarygrass	865	300	200
Sheep sorrel	2,820	*	*
Tansy ragwort	9	0	0
Dandelion	3,323	3,779	2,852
Yellow salsify	4,311	5,274	1,072
Mullein	387	5,366	691

*Not surveyed or treated

**Plant ID for Canada and bull thistle was confused this year, so all plants were lumped together as Canada thistle

Lakeshore

The shore of Crater Lake contains several invasive plant species; the most difficult to control are Canada thistle, St. John's wort, and sheep sorrel (*Rumex acetosella*). These three species are perennial and rhizomatous; in sandy soils it has been possible to extract the entire root mass of some plants, and a reduction in population size has been achieved. In other areas with rocky or harder substrates, manual treatment methods have been less effective especially since plants can sprout from tiny root fragments left behind in the soil. Invasive plants encountered along the lakeshore are

displayed in Figure 17. Comparisons with findings from the 2014 and 2015 field seasons are made in Table 5.

This year, in late July, three days were spent surveying the lakeshore as well as Wizard Island by foot, where possible, and by boat (Figure 16). Almost the entire lakeshore was surveyed with the help of the Lake crew. All together ten invasive species were found and 740 individual plants were treated. Consistent annual treatment of invasive plants over the years has greatly benefited Wizard Island, as only one population of Canada thistle was found on its shores this year.

The lakeshore should be surveyed twice next year to catch invasive plants with delayed phenology. If possible, the lakeshore should be surveyed once at the beginning of August and once at the beginning of September.



Figure 16. The IVM crew surveying for and removing invasive plants along the lakeshore (left); a robust Canada thistle plant was removed near the Wineglass area. Photos by Liv Bly.

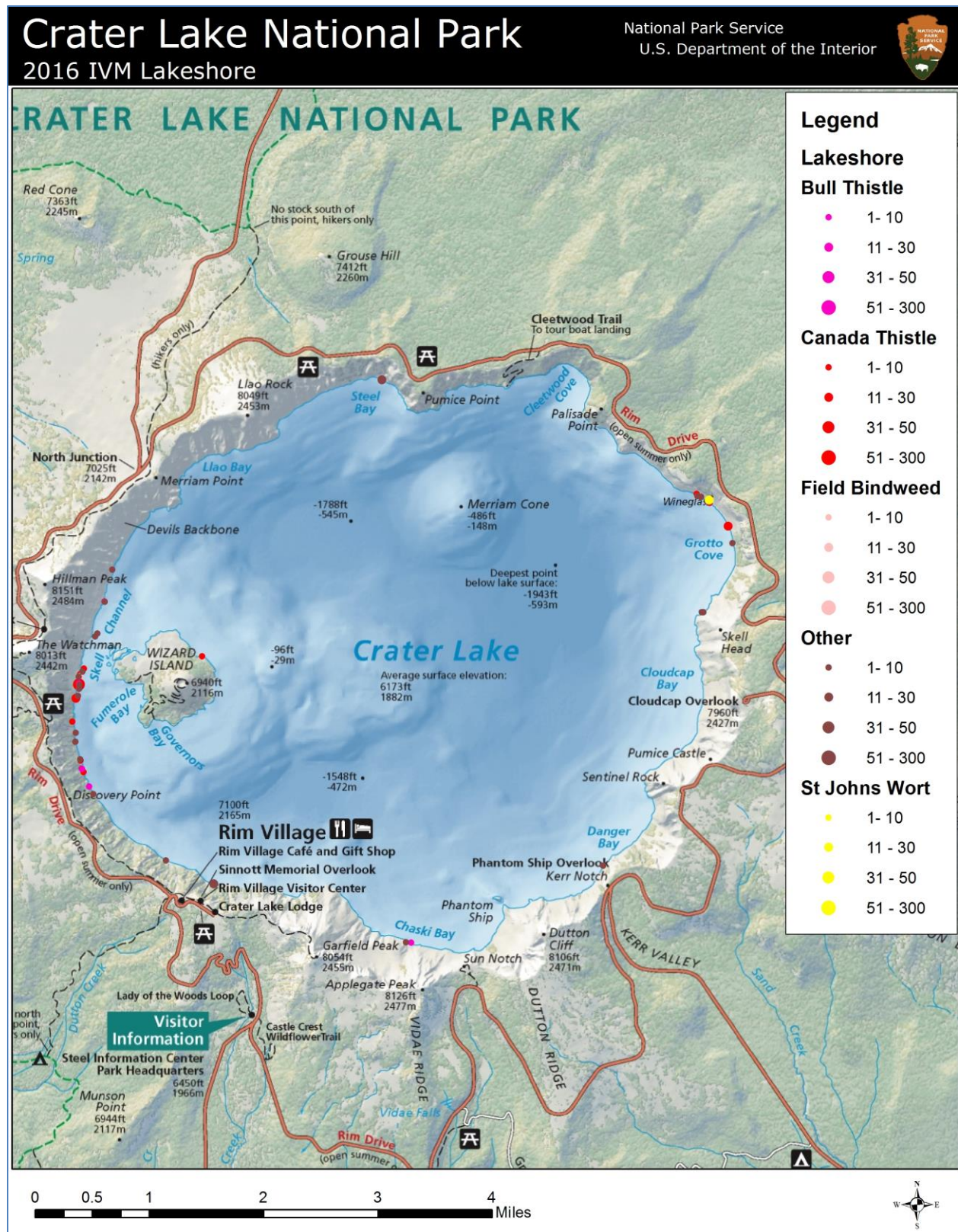


Figure 17. Invasive plants controlled within Park lakeshore areas by the IVM program in 2016. Map by Jen Beck.

Table 5. Number of lakeshore invasive plant species removed in the 2014, 2015, and 2016 field seasons by lakeshore area and by invasive plant species.

Lakeshore Area	2016	2015	2014
Cleetwood Cove to Skell Head	127	147	111
Skell Head to Eagle Point	0	*	*
Eagle Point to Discovery Point	338	*	58
Discovery Point to Merriam Point	203	173	62
Merriam Point to Cleetwood Cove	*	*	*
Wizard Island	5	122	2
Total	673	442	233
Plant Species	2016	2015	2014
Canada thistle	139	99	48
Bull thistle	0	5	0
St. John's wort	81	110	86
Sheep sorrel	300	*	49
Dandelion	77	19	7
Yellow salsify	30	0	0
Mullein	0	78	37

*Not surveyed or treated

Discussion

The 2016 IVM program was very effective at meeting program goals due to the larger size of the field crew and the use of improved tools and techniques. Work accomplished in the 2016 season built upon the hard work of previous field crews, including past survey and control efforts and good documentation. Invasive Vegetation Management will be an ongoing activity for Crater Lake National Park, and reliable funding is needed to ensure that the momentum maintained over many years of annual work is not lost. Without regular and recurring funding, progress made in controlling invasive plants over the past 14 years could be quickly lost and the Park could be faced with a larger and more costly invasive plant problem that is far more difficult to control.

The Park has prepared a new Invasive Vegetation Management Plan (IVMP) and Environmental Assessment that is currently being reviewed through the process of abiding with laws and policies such as the National Environmental Policy Act of 1970. It is hoped that the new IVMP can be implemented soon to greatly improve and enhance the Park's ability to protect native ecosystems through invasive vegetation control and management.

Areas that continue to need to be watched for invasive plant establishment include sites impacted by the 2014 Pavement Preservation project (aforementioned roadsides plus staging areas), and areas impacted by the 2014 Rockfall Mitigation project including the Watchman cut and Wizard Island Overlook stretches on West Rim Drive; and Sun Grade, Dutton Cliffs, and Anderson Point stretches along East Rim Drive. Areas affected by recent fires such as the 2016 Bybee Creek fire, the 2015 National Creek Complex, and the 2014 Pumice Complex require post-fire invasive plant survey and possible treatment, and BAR funds have been secured for this purpose.

Additional recommendations for IVM work in 2016 include:

- Early-season and multiple visits to all invasive grass sites
- Ensure all backcountry cheat grass sites are visited early
- Early-season visits to Cottonwood Meadows, Pothole Creek, Thousand Springs, Sun Creek, and lower Bybee Creek
- Continue surveying Park roadsides for new Jerusalem oak infestations, as well as treating known populations
- Multiple visits to known Canada thistle sites starting in July
- Survey for new smooth brome infestations along Park roadsides
- Focus IVM work in the Red Blanket Canyon to the upper canyon slopes and rim
- Continue to survey along Park creeks especially along the western boundary
- Multiple visits to the Panhandle and Upper Panhandle burn unit

- Monthly visits to Spruce Lake
- Multiple July visits to Poison Meadows to catch yellow salsify (*Tragopogon dubius*)
- Thoroughly search developed areas (e.g., around buildings, in backyards, around utility boxes) for invasive plants
- Survey areas impacted by infrastructure improvements during 2014-2016 (headquarters fiber-optic line, PCT group campsite, Mazama Campground paving, Mazama sewage lagoon access road, Century Link cable trench along Munson Valley Road, Annie Creek Restaurant, Mazama Cabins)
- Continue to refine and improve data collection using Trimble Juno units
- Ensure IVM crew is trained on new geodatabase and Access database and that weekly downloads and backups occur during field season
- Collect voucher specimens for new-to-CRLA invasive plants
- Ensure IVM crew is trained on processing unknown plant specimens
- Schedule at least four days to survey the Lakeshore early in the season with the Lake staff: target the first or second week of August for the first surveys. Walk as much of the lakeshore as possible.
- Survey rock outcrop across from the Godfrey Glen parking lot in August for St. John's wort hidden from pavement edge
- Survey Pole Bridge Creek for invasive plants above and below drafting point for Fire Management operations, and also the upper Pole Bridge Creek Quarry where air operations are based
- Survey fuel reduction areas on west Highway 62 and around Park headquarters that experienced pile burning treatments
- Load more years' worth of data onto the Trimble Juno units
- Check the Dyer's woad (*Isatis tinctoria*) site in front of the Annie Creek Restaurant, and the rush skeletonweed (*Chondrila juncea*) site on Lower Munson Valley Road
- Utilize the Bybee Creek fire and National Creek Complex Burned Area Rehabilitation maps to guide survey and control efforts in these areas
- Survey the area impacted by fire retardant (61,000 gallons) on the ridge south of the Bybee Creek fire

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