



Preventing the Non-Native Plant Invasion of Glacier National Park's Grasslands and High-Elevation Meadows

NRPP Project Final Completion Report

Natural Resource Report NPS/GLAC/NRR—2016/1363



ON THE COVER

Two Dog Flats meadows along the Going-to-the Sun Road in St. Mary Valley, Glacier National Park. NPS photo.

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Executive Summary

The purpose of this project was to combine restoration with integrated weed management to fortify critical grassland and meadow habitats against accelerated invasion by invasive plant species in response to climate change. Targeted invasive species were controlled, followed by native-plant reintroduction. Now that the project has been completed, we will evaluate our methods and material choices with rigorous post-control and restoration treatment assessments that will provide guidance for future work. All work was completed in Glacier National Park during fiscal years 2013–2015.

Project PMIS #: 161482

Park: Glacier National Park

Region: Intermountain

Funding Source: Natural Resources Preservation Program

1 Purpose, Goal, and Objectives

The purpose of this project was to combine restoration with integrated weed management to fortify critical grassland and meadow habitats against accelerated invasion by invasive plant species in response to climate change. All work was completed in Glacier National Park (NP) during fiscal years 2013–2015.

To prevent invasive species, such as cheatgrass, from becoming well established, early detection is necessary, followed by a rapid response to eradicate these initial infestations. This project had several components intended to increase the resiliency of vulnerable and ecologically valuable park lands and enhance the ability of the native flora to ward off non-native plant invasion. Involving volunteers, students, senior rangers, and other partner groups in the implementation of this program provided for outreach and education on the critical issues of climate change. Education highlighted the role citizen scientists and the general public play to influence

the trajectory of ecological change, at least on a park scale.

Specific project objectives were to:

- 1) Verify and map documented cheatgrass populations and survey susceptible habitats for additional populations.
- 2) Develop and implement prioritized treatment strategies to control and contain all identified cheatgrass populations.
- 3) Implement ecological restoration following invasive-plant control treatments, through native-seed collection, propagation, and planting.
- 4) Monitor and evaluate project success and watch for new infestations.
- 5) Provide public education and outreach on the increasing threat of non-native invasive plants to national parks as a result of climate change.

2 Methods and Accomplishments

2.1 Verify and map documented cheatgrass populations and survey susceptible habitats

Glacier NP has an Access/GIS database that was created to map and monitor invasive vegetation in the park. The base format for the database includes acreage infested, weed cover, density, and distribution. The exotics database is maintained in Access and is updated annually to address regional and national inventory and monitoring standards. Weeds targeted for inventory are those on Montana's State Noxious Weed list; cheatgrass has been listed since 2010. Exotic vegetation data are recorded directly on maps and/or by GPS. Maps are digitized and updated using ArcGIS software in order to monitor spread and status of management activities. The existing invasive-plant program and database provided a solid foundation from which to launch this cheatgrass project.

Cheatgrass surveys were initially conducted in areas with known infestations, to update the current database. The field work for this component was started in late May/early June of each year by the park's Integrated Weed Management Crew, with assistance from trained citizen-science volunteers. Throughout the growing season, surveys were conducted to (1) detect new cheatgrass infestations and (2) determine success of treatments and whether re-treatment was necessary. This information was used to identify the highest-priority treatment locations and to develop site-specific treatment strategies. All non-native invasive plant assessments and mapping activities were performed by Glacier's in-park seasonal field crew. Site prioritization for treatment was performed by the park's restoration biologist, along with the field supervisor for Integrated Pest Management (IPM).

Priority areas surveyed included:

- Grasslands: Big Prairie (100 acres); Round Prairie (20 acres); Two Dog Flats (35 acres); St. Mary Flats (25 acres); Rising Sun Meadows (30 acres); and Appikuni Flats (5 acres)

- Road corridors: Going-to-the-Sun Road (57 miles); Camas Road (12 miles); Inside North Fork Road (20 miles); Two Medicine Road (11 miles); and Many Glacier Road (12 miles)
- High-elevation disturbed areas: Logan Pass Highline Trail; Sun Point Picnic Area; The Loop; Road Camp; Lunch Creek; Siyeh Bend; Wild Goose Island Lookout; and Bering Creek.

2.2 Develop and implement prioritized treatment strategies

Herbicide and manual control methods were used to treat existing non-native invasive plant populations.

Glacier National Park's non-native invasive-plant management program focuses specifically on management strategies that target the early detection, prevention, and control of aggressive non-native plants species that threaten the natural landscape. Control techniques include the use of herbicides; manual, mechanical, biological, and cultural methods; and restoration.

Glacier NP's comprehensive [Eastside Grasslands Ecology Report](#) (Asebrook and Shea 2010) provides an overall understanding of the correlation between the condition and integrity of park grasslands and overall biological diversity for both plant and animal species. A comprehensive plant species list for these various grasslands is also included. With an analysis of meadow composition and specific community groups, as well as documentation of the presence and status of non-native invasive plant species, this report provided the baseline data from which to implement the invasive-plant and restoration treatments for this project.

After cheatgrass infestations were documented by survey activities, treatment actions were prioritized, based on the likelihood of success in eliminating a new or small infestation and/or containing larger infestations associated with susceptible habitats (e.g., grasslands, high elevations, wilderness, rare species habitat). The sites most likely to

be “high priority” were those with known cheatgrass infestations (of ~30 acres), including the Middle Fork Boundary Trail, Camas Road (north end) and Going-to-the-Sun Road (Rising Sun to St. Mary.)

For small infestations found early in the spring, hand-pulling was an effective treatment option. Large populations were treated in the fall with the herbicide, Plateau. Invasive-plant control actions were implemented by Glacier NP’s in-house IPM crew.

Cheatgrass populations were treated at four different locations: Big Prairie, St. Mary, Camas Road, and the Boundary Trail. Survey, mapping, and treatment were completed by the in-park IPM crew. Seed collection and seeding were conducted by the park’s native plant restoration and nursery crews.

Management actions were implemented in June, July, August, and September of each year. Volunteers worked side-by-side with park employees to hand-pull targeted invasive-plant populations where herbicide treatment was not needed or was impractical. Trained citizen scientists conducted surveys and mapped infestations in the backcountry. Larger invasive plant infestations with a high management priority were targeted for treatment by the in-park IPM crew. The use of volunteers increased the cost-effectiveness of this project.

2.3 Implement ecological restoration

The treatments were followed by native plant reintroduction to suppress continued invasion. Glacier National Park’s native-plant restoration program is well-known across the National Park Service, and restoration staff are often called upon to provide guidance to other parks as they attempt to develop similar programs. We conducted comprehensive site analyses of selected grassland and high-elevation meadows treated for cheatgrass and other noxious weeds. This information was used to develop a planting plan for the reintroduction of native species into these sites. Plants were selected based on their ability to persist with continued herbicide applications. We emphasized the use of

native species that respond positively under herbicide treatment, such as wild strawberry (*Fragaria virginiana*), sticky geranium (*Geranium viscosissimum*), yellow penstemon (*Penstemon confertus*), soft cinquefoil (*Potentilla pulcherrima*), and common snowberry (*Symphoricarpos albus*). We avoided species that are negatively impacted by herbicide treatment, such as rockcress (*Arabis* spp.), harebell (*Campanula* spp.), knotweed (*Polygonum* spp.), and most members of the sunflower (Asteraceae) and pea (Fabaceae) families. Past monitoring of herbicide treatments demonstrates that most native shrubs show no significant response to the herbicide and are suitable candidates for use in restoration projects.

Glacier NP’s restoration program follows strict genetic guidelines, planting only material from stock collected within the same watershed drainage and from a similar elevation range at a given site. The material must be appropriate to the habitat and blend with surrounding vegetation. The goal for this project was to avoid leaving large gaps in vegetation that provide openings for invasive-plant establishment. Implementation plans were developed for each treatment area. Restoration plans included a thorough discussion of strategies to be implemented, a timeline for all activities, a monitoring proposal, and a budget for staffing and supplies.

2.3.1 Seed collection

Park staff began “seed scouting” early in the 2013 field season to locate adequate and genetically appropriate seed-collection sites and observe the phenologies of target plants, including flowering, pollen shed, seed set, and ripening. Initial collections were made in 2013. Seed was dried and cleaned by Glacier nursery staff, then sent to the Natural Resources Conservation Service (NRCS) Bridger Plant Material Center for additional processing and storage or used by Glacier staff to propagate container material for out-planting. NRCS increased specific grass and forb species to provide sufficient quantities of site-adapted seed to complete the reseed-ing of 30 acres of disturbed area.

2.3.2 Propagation

Glacier NP's native plant nursery was used to propagate grass, forb, and shrubby plant materials. Approximately 10,000 plants were grown and planted for this project. Appropriate species were determined during site evaluations in 2013. Several kilograms of native seed were collected, increased, and used to reseed the treatment sites.

2.3.3 Planting

A comprehensive revegetation implementation plan was developed. This plan provided a timeline for all project activities. Project implementation involved the transportation of materials to the site, plant site selection, ground preparation, planting, mapping, placement of protective barriers, and signing. This work involved members of the Montana Conservation Corps, students from Blackfoot Community College Natural Resources classes, high school students, and park revegetation crews. This project restored 30 acres with re-seeding and approximately 10,000 installed plants.

2.4 Evaluate and monitor project success

A restoration monitoring program has been in place in Glacier since 1991, to provide baseline data for planning and assessment of results. Data collection allows us to determine whether the objectives of completed revegetation projects were met and to evaluate the effectiveness of specific treatments. Data are used to determine future strategies, project trends over time, and improve methods. Monitoring for this project included pre-project site evaluation, mapping of treatment techniques, and establishment of plots for future monitoring. Photos were taken of each plot before any other data were collected. Data collected at each plot included:

- estimated canopy cover of trees and shrubs (by size class), grasses, and forbs;

- a species list of native and non-native plant species with an ocular estimate of their respective canopy covers;
- evidence of soil erosion;
- description of ground cover;
- disturbance history;
- evidence of animal use; and
- description of management treatment.

The data were organized into existing databases, and data from the monitored plots were analyzed. A year-end report summarizing the year's work was prepared, complete with documentation of treatment, planting, monitoring, and results of analysis. We monitored results for the last two years of the project. A monitoring schedule was developed that included additional evaluation at years 2, 3, 5, and 10. Monitoring will continue with future funding.

2.5 Provide public education and outreach

Staff at the Crown of the Continent Research Learning Center (CCRLC) developed resource bulletins about herbaceous plant communities to help visitors understand the importance of preventing the continued invasion of non-native plant species. Bulletins are made available at visitor centers and offices, are distributed in response to public inquiries, and are posted on the park website. Bulletins are provided to campground hosts, concessionaires, and partners, such as Glacier Institute, that frequently interact with park visitors. Interpretive products include resource bulletins, web postings, the Crown of the Continent Invasive Plant Field Guide (Belt and LaFleur 2011), and Glacier's Eastside Grassland: Photographic Comparison Over Time (Shea and Key 2006), PowerPoint presentations, and school curriculum materials. Students and volunteers helped collect and produce plant materials and perform site rehabilitation. They were also introduced to Glacier NP's climate-change concerns and adaptive-management strategies.

3 Budget

This project was accomplished with funding from the National Park Service's Natural Resource Preservation Program (NRPP), along with Federal Lands Recreation Enhancement Act (FLREA) funds. This funding was used to verify and map documented cheatgrass populations. Treatment occurred on two infested acres (herbicide .60; hand-pulled 1.40). The funding was also used to survey susceptible habitats for new infestations (154 acres surveyed) and develop and implement a treatment strategy to control and contain identified cheatgrass infestations.

Finally, funds were used to initiate seed collection and implement seeding strategies for restoration following treatment. All treated areas were reseeded. Seeding also occurred in areas adjacent to the treated zones. Cheat-

grass populations were found in severely disturbed areas; thus, additional seeding of a larger area was necessary to out-compete future non-native invasions. Approximately 30 acres were seeded. Additional plant materials were not installed during the years of this project because the sites were not yet ready for mature plants. Propagated plant materials will be installed after the sites have been treated for invasives for several more years. All of the funds received were obligated in accordance with the project's Implementation Plan.

3.1 Expenditures

All funds were spent according to the budget as proposed (Tables 1–3).

Table 1. Project expenditures, fiscal year 2013.

Item	Description	Unit cost (\$)	Qty	Item cost (\$)
Personal services	GS-9/3 (Term) Forestry Tech (1 pay period)	2,600	1	2,600
	GS-6 Forestry Tech (1 pay period)	1,500	1	1,500
	GS-5 Forestry Techs (1 pay period)	1,300	2	2,600
	GS-9/1 (Term) Bio Tech Reveg/Nursery Supervisor (1 pay period)	2,400	1	2,400
	GS-7/2 (Term) Bio Tech Nursery Manager (1 pay period)	2,100	1	2,100
	GS-6 Lead Bio Tech Reveg (1 pay period)	1,500	1	1,500
	GS-5 Bio Techs (1 pay period)	1,300	4	5,200
	GS-7 Monitor (1 pay period)	2,000	1	2,000
	GS-6 Monitor (1 pay period)	1,500	1	1,500
	GS-5 Interpretive Ranger (0.5 pay period)	650	1	650
	GS-7 Arch Tech (1 pay period)	2,000	1	2,000
	GS-9 Database Manager (1 pay period)	2,400	1	2,400
	Personal services total			\$26,450
Travel and transportation costs	Per diem	4,000	1	4,000
	Rental vehicle	5,000	1	5,000
	Fuel	1,000	1	1,000
	Travel and transportation costs total			\$10,000
Supplies costs	Herbicides	500	1	500
	Safety equipment (gloves, tyvek, safety glasses)	500	1	500
	Pots, media, fertilizer, etc. for plant production	1,000	1	1,000
	Supplies costs total			\$2,000
Equipment costs		0.00	0	\$0
Contractor and cooperator costs	Natural Resources Conservation Service: seed processing/increasing	7,000	1	\$7,000
Other costs (overhead)	2% Glacier Administrative Assessment costs	909	1	909
	1% IMR Assessment costs	455	1	455
	Other costs total			\$1,364
Component net cost				\$46,814

Table 2. Project expenditures, fiscal year 2014.

Item	Description	Unit cost (\$)	Qty	Item cost (\$)
Personal services	GS-9/3 (Term) Forestry Tech (1 pay period)	2,600	1	2,600
	GS-6 Forestry Tech (1 pay period)	1,500	1	1,500
	GS-5 Forestry Techs (1 pay period)	1,300	2	2,600
	GS-9/1 (Term) Bio Tech Reveg/Nursery Supervisor (1 pay period)	2,400	1	2,400
	GS-7/2 (Term) Bio Tech Nursery Manager (1 pay period)	2,100	1	2,100
	GS-6 Lead Bio Tech Reveg (1 pay period)	1,500	1	1,500
	GS-5 Bio Techs (1 pay period)	1,300	4	5,200
	GS-7 Monitor (1 pay period)	2,000	1	2,000
	GS-6 Monitor (1 pay period)	1,500	1	1,500
	GS-5 Interpretive Ranger (0.5 pay period)	650	1	650
	GS-7 Arch Tech (1 pay period)	2,000	1	2,000
	GS-9 Database Manager (1 pay period)	2,400	1	2,400
	Personal services total			\$26,450
Travel and transportation costs	Per diem	4,000	1	4,000
	Rental vehicle	5,000	1	5,000
	Fuel	1,000	1	1,000
	Travel and transportation costs total			\$10,000
Supplies costs	Herbicides	500	1	500
	Safety equipment (gloves, tyvek, safety glasses)	500	1	500
	Pots, media, fertilizer, etc. for plant production	1,000	1	1,000
	Supplies costs total			\$2,000
Equipment costs		0.00	0	\$0
Contractor and cooperator costs	Natural Resources Conservation Service: seed processing/increasing	7,000	1	\$7,000
Other costs (overhead)	2% Glacier Administrative Assessment costs	909	1	909
	1% IMR Assessment costs	455	1	455
	Other costs total			\$1,364
Component net cost				\$46,814

Table 3. Project expenditures, fiscal year 2015.

Item	Description	Unit cost (\$)	Qty	Item cost (\$)
Personal services	GS-9/3 (Term) Forestry Tech (1 pay period)	2,600	1	2,600
	GS-6 Forestry Tech (1 pay period)	1,500	1	1,500
	GS-5 Forestry Techs (1 pay period)	1,300	2	2,600
	GS-9/1 (Term) Bio Tech Reveg/Nursery Supervisor (1 pay period)	2,400	1	2,400
	GS-7/2 (Term) Bio Tech Nursery Manager (1 pay period)	2,100	1	2,100
	GS-6 Lead Bio Tech Reveg (1 pay period)	1,500	1	1,500
	GS-5 Bio Techs (1 pay period)	1,300	4	5,200
	GS-7 Monitor (1 pay period)	2,000	1	2,000
	GS-6 Monitor (1 pay period)	1,500	1	1,500
	GS-5 Interpretive Ranger (0.5 pay period)	650	1	650
	GS-7 Arch Tech (1 pay period)	2,000	1	2,000
	GS-9 Database Manager (1 pay period)	2,400	1	2,400
	Personal services total			\$26,450
Travel and transportation costs	Per diem Fuel	4,000	1	4,000
	Rental vehicle	5,000	1	5,000
	Fuel	1,000	1	1,000
	Travel and transportation costs total			\$10,000
Supplies costs	Herbicides	500	1	500
	Safety equipment (gloves, tyvek, safety glasses)	500	1	500
	Pots, media, fertilizer, etc. for plant production	1,000	1	1,000
	Supplies costs total			\$2,000
Equipment costs		0.00	0	\$0
Contractor and cooperator costs		0.00	0	\$0
Other costs (overhead)	2% Glacier Administrative Assessment costs	1,154	1	769
	1% IMR Assessment costs	385	1	385
	Other costs total			\$1,154
Component net cost				\$39,604

3.2 Matching funds

A summary of the matching project funding is presented below. Requested NRPP funds (\$133,232) represent 48% of total project

costs, with 52% (\$145,930) being contributed by project partner, park, and volunteer contributions (Table 4). Total project costs equal \$279,162.

Table 4. Amount of project support provided in matching funds.

Item	Description	Cost/Value (\$)	Percent of total project cost	Item cost
Glacier National Park in-kind support	1 GS-5 seasonal assisting with the development of communication tools (0.5 pay period x3 yrs)	1,950		1,950
	1 GS-5 seasonal stewardship coordinator (1 pay period x3 yrs)	3,900		3,900
	Park In-kind support total		2.1 %	\$5,850
Donated supplies and equipment costs	Spray equipment for 3 yrs	3,500		3,500
	EPMT spray equipment for 3 yrs	1,500		1,500
	IPM vehicle and gas for 3 yrs	6,000		6,000
	Revegetation vehicle and gas for 3 yrs	6,000		6,000
	Nursery vehicle and gas for 3 yrs	3,000		3,000
	NRM-EPMT vehicle and gas for 3 yrs	3,000		3,000
	Printing materials	800		800
	Donated supplies and equipment costs total		8.5 %	\$23,800
Non-federal contributions	Glacier National Park Fund	23,000		23,000
	Glacier National Park Associates	2,000		2,000
	Dr. Anne Nathe (University of Alberta)	2,500		2,500
	Cyndi Smith (Waterton Lakes National Park)	2,500		2,500
	Non-federal contributions total		10.8 %	\$30,000
Volunteer services costs	500 volunteer hours x \$21.36/hour		3.8 %	\$10,680
Other contributions	FLREA Park Lands Restoration Project			
	2 GS-5 Forestry Techs (1 pay period x3 yrs)	7,800		7,800
	4 GS-5 Bio Techs (1 pay period x3 yrs)	15,600		15,600
	Montana Conservation Corps for 2 weeks/year			24,000
	Federal Highway Lands Program			
	1 GS-6 Bio Tech (1 pay period x3 yrs)	4,500		4,500
	1 GS-5 Bio Tech Monitor (1 pay period x3 yrs)	3,900		3,900
	1 GS-6 Bio Tech Monitor (1 pay period x3 yrs)	4,500		4,500
	1 GS-7 Bio Tech Monitor (1 pay period x3 yrs)	6,000		6,000
	Northern Rocky Mountain EPMT			
	2 GS-5 Forestry Techs for (1 pay period x3 yrs)	7,800		7,800
	Per diem (x3 yrs)	1,500		1,500
	Other contributions total		27.1 %	\$75,600
Project support cost estimate totals			52 %	\$145,930

Source for the dollar value of volunteer time: <http://www.independentsector.org>. Date of estimate: February 21, 2012.

NRM-EPMT EPMT = Northern Rocky Mountain Exotic Plant Management Team

FLREA = Federal Lands Recreation Enhancement Act

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