Southwestern Crown of the Continent Collaborative

Five-Year Monitoring Summary (2010-2014)

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I. Introduction

The end of 2014 marked the five-year point of the US Forest Service's Collaborative Forest Landscape Restoration Program (CFLRP). The Southwestern Crown Collaborative (SWCC) was one of the original ten projects across the country selected to receive CFLRP funding. Since 2010, the SWCC Monitoring Committee has been monitoring restoration treatments conducted on the Flathead, Lolo, and Helena National Forests. We have begun to see results in both restoration and monitoring efforts. Our goal is to use those observations in an adaptive management framework to improve, or validate, existing restoration approaches. Some monitoring results have already been used to plan or alter existing projects.

This report summarizes the monitoring projects conducted by the SWCC Monitoring Committee from 2010-2014. The Monitoring Committee includes four working groups: Socioeconomics, Vegetation, Wildlife, and Aquatics. These working groups helped develop the individual projects while keeping in mind opportunities for integration across resource areas. The SWCC Monitoring Committee has held three Adaptive Management Workshops where monitoring approaches and results have been shared and discussed. Presentations and summaries from those workshops are available at: http://www.swcrown.org/monitoring/swcc-adaptive-management-workshops/.

Members of the SWCC Monitoring Committee are also expanding existing efforts and partnerships through "citizen science" monitoring as a means to engage and inform local communities about climate and natural resource issues. Coordinators work directly with students and community members to monitor water quality/quantity and forest conditions. We have created a network of monitoring sites in and around the small communities of the SW Crown. We have developed a set of protocols, detailed instructions, data sheets, and curriculum to help students and other community members collect and analyze data on forests and streams in the Southwestern Crown. For additional information go to: http://www.swcrown.org/?p=1923.

Additional information and links about the monitoring program, including reports and data, are available at: http://www.swcrown.org/monitoring/.

II. Monitoring Project Summaries

The project summaries provided on the following pages include the key findings and links to reports or other materials available on the SWCC webpage (www.swcrown.org).

Southwestern Crown Collaborative Monitoring Program

Fire Program Cost Savings

What is being monitored and why is it being monitored?

We are estimating the cost savings to the fire management program from fuels and restoration treatments conducted under the Collaborative Forest Landscape Restoration Program (CFLRP). One of the primary goals of the CFLRP was to facilitate the reduction of wildfire management costs, including through reestablishing natural fire regimes and reducing the risk of uncharacteristic wildfire.

How are we monitoring?

We are using a combination of modeling tools, the Risk and Cost Analysis Toolkit (R-CAT), that includes estimates for suppression costs (pre- and post-treatment), treatment implementation costs and revenues, and duration of treatment effectiveness. The modeling was done for 10 of the CFLRP projects nationally, including the Southwestern Crown of the Continent Collaborative.

Key Findings:

- The scale of estimated treatment varied across all projects, ranging from 38,319 to 179,594 acres, averaging 124,000 acres. The SWCC estimated 89,710 treatment acres for 2010-2024.
- The average duration of treatment effectiveness within each large landscape treatment package ranged from 10-20 years. The SWCC used 20 years.
- Expected revenues ranged from $0 to more than $31 million. The SWCC estimated $10.08 million.
- Expected treatment costs ranged from $11.7 million to $72.6 million over the life of the project. The SWCC estimated $14.36 million.
- For five of the seven teams, modeling shows lower mean annual large fire season costs following treatment, and, for two teams mean costs are expected to increase slightly.
- The results ranged from $5.3 million in total suppression savings to a net increase in suppression costs of $3.5 million. The SWCC had a suppression cost savings of $630,046.
- There is room for growth in fuel treatment planning to leverage emerging tools to enhance reliance on concepts such as the strategic placement of treatments.
- Only by linking the financial (reduced loss) and non-financial benefits (resource protection, firefighter safety) can we really assess the prudence of fuel treatment investments against each other and compared to other spending options.

How will this information be used?

This information will be used to anticipate if the goals of the CFLRP for fire management cost savings are being met and the expected level of financial investment in achieving other fuel treatment and restoration goals. It can also help determine if treatments are being implemented at a scale large enough to result in fire management cost savings.

Next steps: The modeling may be repeated at the end of the CFLR program, likely in 2020.

Reports and Resources:

- R-CAT User's Guide: http://www.fs.fed.us/restoration/documents/cflrp/R-CAT/CFLRPWildifreR-CATUsersGuide01192011.pdf
- Presentation on R-CAT: http://www.swcrown.org/wp-content/uploads/2011/01/Fire-Management-Cost-Savings-R-CAT.pdf
- Fire Manager Baseline Interviews: http://www.swcrown.org/wp-content/uploads/2014/07/Fire-Manager-Baseline-Final.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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Partners:

Flathead, Helena, Lolo, and Deschutes National Forests
USFS Northern Region
USFS Rocky Mtn Research Station
USFS Pacific Northwest Research Station

Table 1. Estimated discounted suppression costs savings (investments) and fire program cost savings (investments) for the ten CFLRP projects modeled using R-CAT.

Region	CFLRP Landscape	Total Discounted Suppression Cost Savings for Life of Treatments	Total Discounted Fire Program Costs Savings (Investment)
1	Southwestern Crown of the Continent	$ 630,046	$ (2,924,780)
1	Kootenai Valley Resource Initiative	$ 355,354	$ 5,311,461
2	Uncompahgre Plateau	$1,774,504 to $4,416,800	($6,412,727) to ($3,770,432)
3	Southwest Jemez Mountains	$ 1,339	($58,976, 870)
4	Weiser-Little Salmon Headwaters	$ (300,816)	$ (7,983,348)
6	Deschutes Skyline	$ 2,763,695	$ (8,904,446)
6	Lakeview Stewardship	$5,102,945 to $5,255,665	$1,853,698 to $2,006,418
6	Southern Blues Restoration Coalition	($3,528,781) to $1,577,147	($25,365,306) to ($20,259,378)
6	Northeast Washington Forest Vision 2020	$1,420,695 to $4,086,243	($9,528,851) to ($6,863,343)
9	Missouri Pine-Oak Woodlands Restoration	($53,003) to $24,935	$2,771,361 to $2,849,299

What is being monitored and why is it being monitored?

We are monitoring local fire manager perceptions of the effectiveness of the Southwestern Crown of the Continent (SW Crown) Collaborative Forest Landscape Restoration (CFLR) Project at reducing fire behavior and fire management costs. We also asked fire managers whether this large landscape project is expanding options for fire managers from multiple agencies to allow fire to play its historic role in forest disturbance. These are primary goals of the CFLR program.

How are we monitoring?

A questionnaire was developed and sent to federal, state, and local fire managers in the SW Crown in 2012. There were 18 respondents to the online survey, representing a 60% response rate. Follow-up discussions were held with respondents in 2013. The information forms a baseline of perceptions early in the CFLR Program from which we can compare changes as the program progresses.

Key Findings:

- Most fire managers felt fuel treatments, in general, are able to reduce potential fire intensity in stands where they are conducted. All Forest Service respondents selected "most of the time".
- The perception of the pace of fuel treatment, since CFLRP started, was mixed with most ranging from *somewhat faster* to *somewhat slower*, with little or no change in treatment placement effectiveness on public lands. But some respondents indicated improved placement on NFS and private lands. Forest Service respondents mostly saw no change in placement on NFS land since CFLRP started.
- Most fire managers seem to indicate fuel treatments are making *some progress* or *little progress* keeping up with fuel accumulation in the SW Crown. Not a single respondent indicated we are *making considerable progress* in reducing fuel accumulation.
- Community Wildfire Protection Plans that are in place for the SW Crown area are *mostly influencing* treatment locations.
- Treatment longevity (for management and fire treatments) generally suggested a range of 10-20 years with some outliers indicating zero if not burned, 7 years for some fuel types, but even up to 40 years. Factors perceived to control this were *new density, time since previous burn, previous burn severity, species composition, and new crown spacing*.
- Short-term threats to treatment effectiveness are fuel seasoning from piling and scattering of fuels prior to prescribed burning windows being open. There may be opportunities to reduce these short-term threats by incentivizing removal of small or non-saw activity fuels.
- The greatest potential long-term threats from fuel treatments were higher winds (43%) and greater solar incidence (43%).
- A real mix of opinion exists about expanded options for fire managers to allow portions of fires to burn more freely following vegetation and fuel treatments since 2010.

How will this information be used?

The intent is to use this information in adaptive management and to substantiate analyses of fire management costs in the Risk and Cost Analysis Toolkit (R-CAT). The monitoring will provide feedback on the potential effectiveness of fuel treatments over the course of the CFLR Program in the SW Crown. Feedback from fire managers will spatially inform line officers about if and how much fuel treatments are creating opportunities to allow naturally ignited fires to burn, reducing costs, and achieving cost-effective fuel treatments.

Next steps: Current plans call for replication of this survey effort two more times as part of the long-term monitoring plan. It is expected that this would be done in roughly 5 years (2017) and 10 years after the baseline (2022).

Reports and Resources:

- Baseline Southwestern Crown of the Continent CFLRP Fire Manager Study: http://www.swcrown.org/wp-content/uploads/2014/07/Fire-Manager-Baseline-Final.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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Partners:

Flathead, Helena, and Lolo National Forests
USFS Northern Region
Swan Ecosystem Center
University of Montana
Bureau of Land Management
Montana Department of Natural Resources and Conservation

Prescribed burns in the Meadow Smith project on the Flathead National Forest and the Alice Creek Ecoburn on the Helena National Forest, respectively.

What is being monitored and why is it being monitored?

We are monitoring the contracts and agreements awarded to implement and monitor treatments conducted under the Collaborative Forest Landscape Restoration Program (CFLRP). One of the goals of the CFLRP is to "benefit local economies by providing local employment or training opportunities." This project explores the extent to which local contractors, organizations, and workers are benefiting from CFLRP opportunities in the SW Crown.

How are we monitoring?

We measure the rate of local contractor participation in the SW Crown CFLRP project as an indicator of benefits to local communities and compare these rates to similar restoration activities occurring in a 5-county reference area surrounding the SW Crown project boundary. In addition, the project provides the implications of defining the term "local" by conducting the analysis at multiple geographic scales.

Key Findings from 2010-2011:

- Annual service contract spending on restoration activities increased in the 5-county study area from roughly $2 million in fiscal year 2005 to over $5 million in fiscal year 2011.
- Local contractors were slightly less successful, in terms of dollar value, at capturing CFLRP service contracts (2010-2011) compared to contracts awarded in the reference counties. However, when businesses located in adjacent counties were included, this group was significantly more successful in capturing CFLRP opportunities.
- Capture rates varied significantly according to the type of work being conducted. Local and semi-local contractors captured 82% of equipment-intensive contract value, 100% of technical contract value, 31% of labor-intensive and none of the product procurement value.
- The total volume of timber sold annually by the three forests in the reference area (Lolo, Flathead, and Helena National Forests) varied during the period from about 50 million board feet (MMBF) in fiscal year 2005 down to 24 MMBF in fiscal year 2011.
- Nearly all timber sales in the reference area were purchased by Montana firms, with two purchased by firms whose address could not be located.
- Of the 28 stewardship contracts sold, only one was purchased by an out-of-state firm.
- Only three timber sales were sold during the first two years of the CFLRP, generating just over 3 million board feet (MMBF) in timber, one of which was offered as a stewardship contract.
- Over $2 million was invested through the CFLRP in agreements with 17 local organizations and state and federal agencies. These funds were leveraged by an additional $1.5 million in cash and in-kind donations provided by partner organizations. More than 80% of the funds invested through CFLRP went to local non-profits and an additional 17% to state agencies.
- Overall, the data indicate that contractors in the SW Crown are capturing a majority of restoration opportunities generated in the form of service contracts, timber sales, stewardship

contracts and agreements. These trends imply that a certain level of local capacity exists to meet the needs of the SWCC and CFLRP.

- There continue to be significant gaps in the areas of labor-intensive service work, stewardship contracts, product procurement, and to a lesser extent, technical consulting work.
- There is evidence that Small Business Administration programs designed to give preference to minority-owned and economically-disadvantaged businesses are having negative impacts on the utilization of local businesses and, by extension, the benefits accruing to local communities.

Recommendations:

- Federal contract monitoring efforts are hindered by poor data availability. Specifically:
  - Contract data should include higher resolution project location data. At present, the only information available is the county in which the contract activities took place.
  - A common core of information across service, timber, stewardship and agreements would facilitate analyzing and communicating the impact of all of these mechanisms together.
  - There is evidence that the impacts of subcontracting may be significantly different, and more local, than that of prime contractors, which has important implications on the benefits being captured by rural, forest-dependent communities located near CFLRP projects. At present, little is known about these impacts and the data are not available from the Forest Service.

How will this information be used?

The results will track how CFLRP funds are being spent and whether the program is meeting it's goals. They will also help to understand whether additional steps are needed to improve the competitiveness of local communities in retention of CFLRP funds.

Next steps: In 2015-2016, we plan to conduct an analysis of contracting trends covering the first 5 years of CFLRP implementation.

Reports and Resources:

- 2012 Contract Monitoring Report: http://www.swcrown.org/wp-content/uploads/2014/07/SWCC-Contract-Monitoring-Report-2012_FINAL.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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Partners:

University of Montana, Bureau of Business and Economic Research (BBER)
Flathead, Helena, and Lolo National Forests

What is being monitored and why is it being monitored?

All Collaborative Forest Landscape Restoration Program (CFLRP) projects are required to conduct multi-party monitoring "to assess the positive or negative ecological, social, and economic effect" of activities implemented under the program. This report summarizes results from an initial project of the Southwestern Crown Collaborative (SWCC) Socioeconomic Monitoring Working Group conducted in spring 2012 to get a sense of issues, language, and indicators related to social attitudes and concerns about forest management in the landscape.

How are we monitoring?

Nine people from the three main watersheds in the landscape were selected to represent a range of interests and interviewed on their concerns related to the following topics: 1) views of existing forest conditions in the project area; 2) personal forest product use in the project area; 3) forest aesthetics; 4) concerns related to road use and closure; 5) forest recreational use; 6) trust and commitment to public forest land management; 7) concerns related to wildfire and 8) knowledge of and approval towards the SWCC projects and 9) preferences for public participation and communication with the SWCC CFLRP. We constructed an interview questionnaire to guide each interview.

Key Findings:

- Even among nine people views on forest management and conditions differed widely. Viewpoints differ depending on an individual's understanding and acceptance of natural processes, especially as they relate to historic forest disturbance. For example, some are more accepting of beetle-killed trees and burned forests while others see dead trees as a fire risk and lost timber value.
- The main forest products that respondents collected from the SWCC forests included: food (game animals, mushrooms, berries), firewood, timber/logs, and gathering as recreation. People expressed the importance of forests for household consumption, for some as a primary input to their livelihood.
- Most of the people we interviewed agreed about what constitutes a beautiful forest including an abundance of green trees, clean and cold water, and many flowers and wildlife.
- All of those interviewed noted the importance of the topic of road use and closures and that it is highly charged and political. Among the nine people we spoke to approximately half said that there are too many forest roads (four of the nine), while the remaining five said that there are just the right amount of roads. No one felt that there were too few forest roads.
- Every respondent we interviewed reported engaging in at least one (and usually several) types of recreational activities somewhere in the SWCC CFLRP area. A key difference is between motorized (4 respondents) versus non-motorized (5 respondents) recreation.
- Fire is a very sensitive and emotionally charged topic, similar to discussions about roads. Responses ranged from accepting wildfire as a process of nature with minimal tolerance for

intervention to mitigate fuels to viewing wildfires and fuel mitigation as the result of both natural and human forces but which needs to be aggressively approached.

- When asked about whether they trusted the Forest Service four respondents answered "yes", three respondents answered "no", and two had "no opinion". Responses suggest that respondents judged the Forest Service on specific examples and organizational trends, but also the actions of individual people and offices.
- Those interviewed had an array of different opinions about the ways that the SWCC CFLRP was (or was not) communicating with citizens and how the public might be better involved. They also reported a variety of opinions regarding different communication strategies, suggesting a variety of methods for communicating with residents in the SWCC should be employed.
- Special attention needs to be focused on identifying and prioritizing particular communities for monitoring the social impacts associated with activities and treatments occurring near to them.
- There is also a need to continue collecting information to improve understanding of social and economic conditions in the Southwestern Crown area as well as to ascertain how the project is specifically affecting these conditions.

How will this information be used?

These interviews were one of the first data collecting activities undertaken under the auspices of the Socio-economic Working Group. The purpose was to identify issues of concern, common language and potential indicators for use in future monitoring. It will be used to inform the upcoming social survey and to identify better ways to communicate amongst partners and the general public.

Next steps: A landscape-wide social survey is currently being developed to further assess stakeholder's viewpoints on forest management activities.

Reports and Resources:

- Social Assessment Report: http://www.swcrown.org/wp-content/uploads/2014/07/Bosak-Belsky-Interviews-Final-Report-april-29-2013.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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Partners:

College of Forestry and Conservation, University of Montana
Flathead, Helena, and Lolo National Forests

What is being monitored and why is it being monitored?

One of the key requirements of the CFLRP is "to assess the positive or negative ecological, social, and economic effects of projects." We are monitoring local residents,' communities,' and stakeholders' perspectives on forest management and decision-making processes in the SW Crown under the Collaborative Forest Landscape Restoration Program (CFLRP). Among our measures are people's attitudes toward completed and ongoing restoration projects and their priorities for future work.

How are we monitoring?

We plan to distribute a quantitative mail survey in late 2015 throughout the SW Crown landscape. The topics covered in the survey are described below.

Categories of Questions in Social Survey

- **Effectiveness of CFLRP toward achieving project goals**: These questions would measure perceptions of whether or not progress has been or is being made toward the CFLRP's intended project goals, such as:
  - improving job opportunities and contributing to a healthy economy
  - reducing fire hazards both in the WUI and across the landscape
  - improving fish and wildlife habitat and water quality, and reducing invasives
  - providing recreational opportunities, and
  - contributing to the sustainability of communities within the SW Crown.
- **Involvement/Participation**: These questions would track general perceptions of inclusion and opportunity for inclusion in National Forest decision making processes, such as:
  - Whether residents believe their interests and concerns are being considered and addressed within current decision making processes (collaboration, NEPA, etc.)
  - Whether residents believe there is adequate opportunity to be involved
- **Trust in Forest Service and CFLRP Process**: These questions would focus on perceptions of transparency and fairness in decision-making processes, such as:
  - Whether residents trust that the process is open, honest, and fair
  - Whether residents trust that their participation in the process will result in management changes, if needed
  - If there is lack of trust, what is the cause of the mistrust?
- **Forest Management Values**: These questions would assess how underlying values inform preferences for management alternatives, such as:
  - What makes this place unique and important?
- **Preferences for Restoration Treatments**: These questions would measure general public preferences and prioritization for types of restoration activities and where, generally, they should be focused within the landscape, including:
  - Attitudes towards restoration activities, such as: road management, fuels treatments,

invasive species control, prescribed burns, and habitat restoration
  - Where residents think these activities should be focused (e.g. WUI, outside WUI, low-severity, mixed severity stands, etc.)
  - Attitudes toward specific tools (e.g., prescribed fire)

How will this information be used?

Results will be used to identify avenues for improved involvement, communication, and prioritization of restoration treatments. For example: How can we better engage people in the decision-making process? Where are there disconnects between ecological knowledge and social perceptions? What aspects of trust are lacking? Why do people support or oppose activities? Where can we maximize overlap between social values and project goals?

Next steps: We are currently undergoing the approval process at the Federal Office of Management and Budget (OMB) to implement our survey. If approved, we plan to test and distribute the survey in late 2015 and analyze the results in early 2016. The survey will then be repeated after the 10 years of the CFLRP, probably in 2023.

Reports and Resources:

- Initial SWCC Social Assessment Report: http://www.swcrown.org/wp-content/uploads/2014/07/Bosak-Belsky-Interviews-Final-Report-april-29-2013.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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Partners:

Flathead, Helena, and Lolo National Forests
College of Forestry and Conservation, University of Montana
Bureau of Business and Economic Research, University of Montana

Field trips and workshops held in the SW Crown as part of the CFLR program.

What is being monitored and why is it being monitored?

Forest vegetation management with mechanical treatments and prescribed fire are the primary tools used by SWCC managers to meet forest restoration and fuel management objectives. This project is monitoring the positive and negative ecological effects of vegetation management treatments. More specifically, we are monitoring effects on forest structure and composition, tree mortality and regeneration, fuels, soils, and native and non-native plants.

How are we monitoring?

We are using the USFS Northern Region Common Stand Exam protocols for our measurements (see link below). In 2012, we installed: 30 pre-treatment plots (and 20 control plots) in the Auggie Fuels project, 40 pre-treatment plots in the Colt Summit project, and 20 pre-treatment plots (and 20 control plots) in the Stonewall project. These plots will be re-measured post-treatment, starting in 2016, and then every 3-5 years after that.

Key Findings:

- Pre-treatment data summary coming soon.

How will this information be used?

Monitoring results will be used to assess implementation success and treatment effectiveness over the short term, allowing managers to adjust prescription design and implementation strategies to better achieve treatment objectives in future treatments. Over the medium to long term this project will generate a core dataset characterizing baseline conditions and ecological effects, enabling adaptive decision making. The robust design—including controls and replication—will permit informed adaptive management: we will be able to differentiate between effects actually due to treatments from effects caused by other chance events (e.g., mountain pine beetle outbreak) so that inferences about treatment effects and subsequent adaptive decisions are based on sound, defensible facts.

Next steps: Post-treatment monitoring of existing sites will be conducted in 2016 and new plots will be installed at upcoming projects in future years.

Reports and Resources:

- Pre-treatment data report coming soon.
- USFS Northern Region Common Stand Exam Manual: http://www.swcrown.org/wp-content/uploads/2014/11/RI-CSE-Manual.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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Partners:

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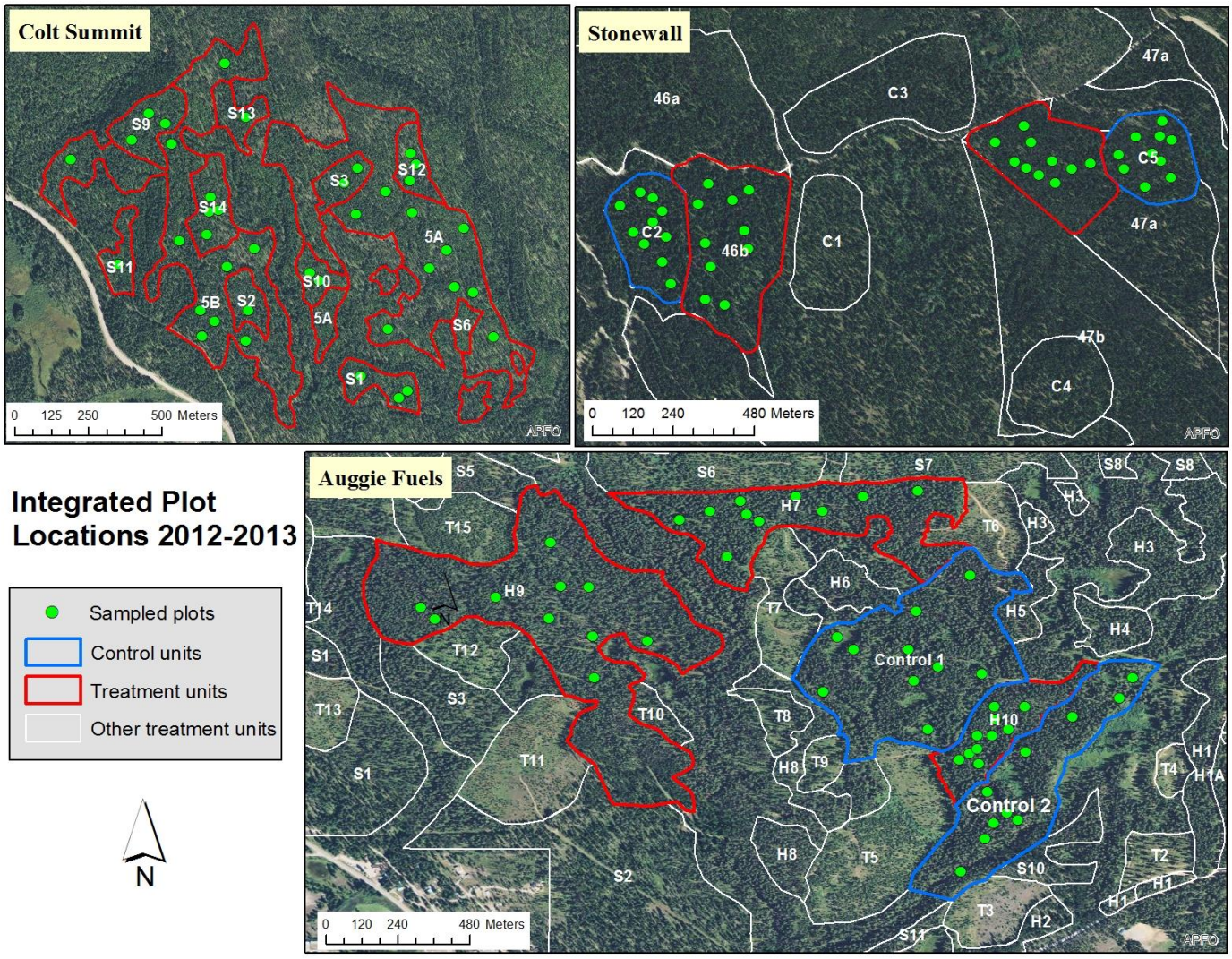

Southwestern Crown Collaborative Monitoring Program

Old-Growth Monitoring

What is being monitored and why is it being monitored?

We are monitoring vegetation within forest stands of the Meadow Smith project on the Swan Lake District of the Flathead National Forest. The Northern Region of the Forest Service (Region 1) is particularly interested in increasing resilience of old-growth and mature forest stands. Since this was also one of the goals of the Meadow Smith project and there were stands which met the definition of old growth, we installed monitoring plots in the project area. Maintaining large trees is also a goal of the Collaborative Forest Landscape Restoration Program (CFLRP).

How are we monitoring?

In the fall of 2008, 18 control plots were installed across two non-treatment areas of two stands and 37 treatment plots were installed across treatment areas of the same two stands. All of these units are within the WUI. The units were mechanically harvested during the winter of 2010-2011. One unit received an understory burn in 2012 and two units were burned in 2013. Plots were re-measured post-treatment. We measured live trees, snags, canopy cover, woody debris, and fuels. Collected data was input into models to estimate potential for: fire behavior and insect hazard.

Key Findings:

- Remaining trees in two of the three treatment units met old-growth criteria. The third unit experienced a strong wind event post-treatment that killed some trees and it is expected to meet the criteria in a few years.
- Two of the three treatment stands met targets for number of snags retained. The third stand may have lost snags in the same wind event.
- Fire crowning potential was reduced to low in all three stands which means a high (>40mph) wind speed is needed to move a fire into and carry a crown fire.
- Torching potential was not changed in any of the units. It remained low in one unit meaning a high wind speed (> 40 mph) is needed to cause torching. One unit remained high, meaning a low wind speed (0-15mph) could still cause torching. One unit remained moderate (15-40mph wind speed needed).
- Fire type was not changed in any of the units. One unit remained "passive crown" and the other two units were "surface fire" pre-treatment and remained so.
- Risk of mountain pine beetle was removed for lodgepole pine and reduced in two of three stands for ponderosa pine (from moderate to low and high to moderate). In one unit it remained moderate.
- Risk of spruce budworm was reduced to low for two of three stands and remained moderate in one unit.
- Douglas-fir beetle risk was reduced from moderate to low for all three treatment stands.

How will this information be used?

This information will be used to inform the Northern Region and SWCC if old-growth conditions are being created or maintained by treatments at the project scale. If not, adjustments to future treatments can be made.

Next steps: The plots will be remeasured every five years (2019 and 2024).

Reports and Resources:

- Meadow Smith Old-growth Monitoring Progress Report (Post-mechanical treatment): http://www.swcrown.org/wp-content/uploads/2014/07/Meadowsmith_Mon_Rep_2014.pdf
- Northern Region Old-growth Monitoring Protocols: http://www.swcrown.org/wp-content/uploads/2014/07/MeadowSmith_OG_Mon_Inv_Protocols.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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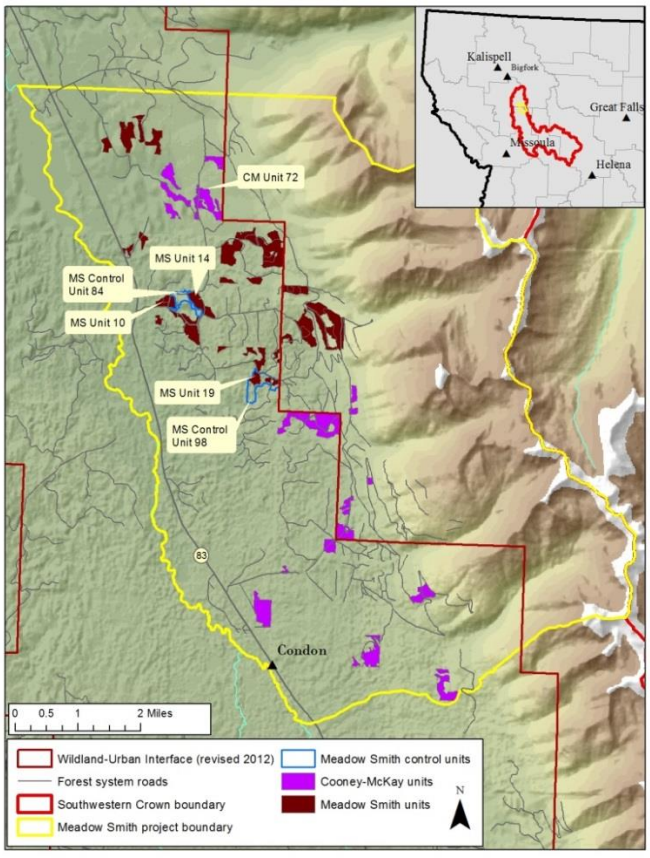
Partners:

Flathead National Forest USFS Region 1 Northwest Connections



Location of Meadow Smith and Cooney McKay units.

Prescribed burn in Meadow Smith unit 30 (May 24, 2012).

Southwestern Crown Collaborative Monitoring Program

Fuels Monitoring

What is being monitored and why is it being monitored?

We are monitoring the effects of forests treatments on fuel levels, to observe how long the effects last, and to explore if silvicultural objectives were met. Two of the primary goals of the Collaborative Forest Landscape Restoration Program (CFLRP) are to reduce uncharacteristic wildfire and to implement treatments that reduce forest fuels. This project will help us determine if fire behavior and fuels objectives are being met at the project scale.

How are we monitoring?

Two sites were selected for monitoring, one control and one treatment. The control had 8 plots installed in the fall of 2011; the treatment unit had 15 plots installed at the same time. Mechanical treatment was completed in the winter of 2011/2012 and the unit was not scheduled for an underburn. The 15 treatment unit plots were re-measured in the summer of 2012. In each plot, we measured all trees, down-woody material, and canopy cover. Tree damage from insects and disease were also recorded. The collected data was entered into models to determine potential fire behavior and insect risk.

Key Findings:

- The target for remaining tree basal area (100-200 ft^2/acre) was not met (95 ft^2/acre), though it should be met in a few years. The number of trees per acre target (150-300) was met (267 trees per acre).
- There were two targets set for canopy cover: 50% (for whitetail deer thermal cover) and a range of 30-70%. The post-treatment measurement was 32%; however this is expected to increase rapidly.
- The target for number of snags retained (6 snags/acre 12-20 inches DBH) was met (10.7 snags).
- The modeled risk to Douglas-fir beetle was reduced from moderate to low. All other insect risk levels remained moderate.
- The modeled fire type was changed from passive crown fire to surface fire.
- Torching index, the wind speed needed to move a surface fire into the canopy, was increased substantially (0 to 506 mph). The wind speed to maintain a crown fire was also increased (46 to 61 mph).

How will this information be used?

This information will be used to inform the Northern Region and SWCC if fuels objectives are being met by treatments at the project scale. If not, adjustments to future treatments can be made.

Next steps: Plots will be remeasured every five years (2017 and 2022).

Reports and Resources:

- Cooney McKay Fuels Project Monitoring Progress Report: http://www.swcrown.org/wp-content/uploads/2014/07/Effect_Monitoring-Rep_CooneyMcKay_2013.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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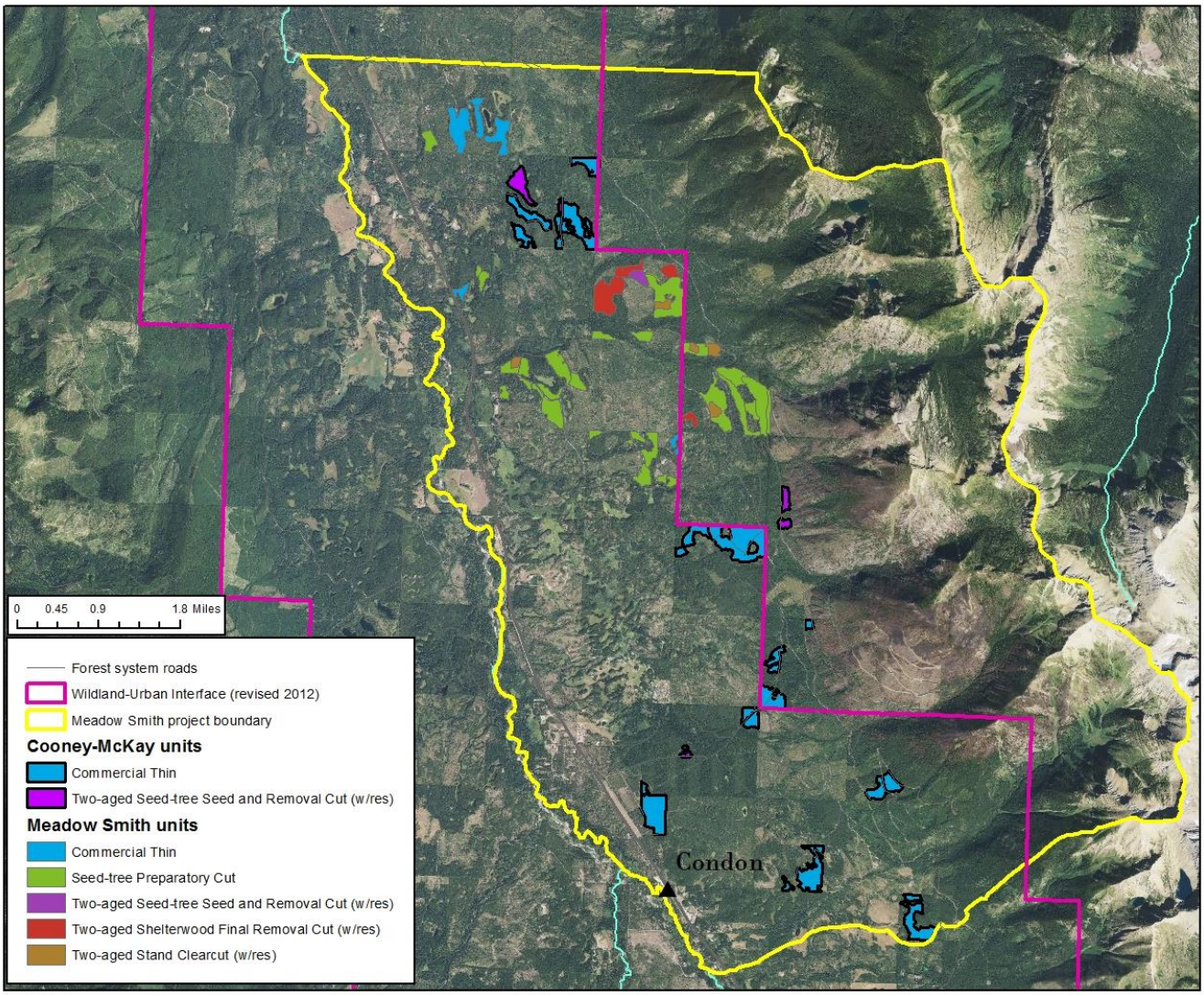
Partners:

Flathead National Forest

USFS Region 1



Cooney McKay units are in bold outline. They are interspersed with units from the Meadow Smith project. Almost all units are in the Wildland-Urban Interface (WUI). Monitoring plots were installed in the northern-most units.

What is being monitored and why is it being monitored?

This project is monitoring rehabilitation seed mix germination and survival (persisting into the next growing season) on low to mid elevation, moisture stressed sites throughout the SW Crown planning area, including landings, decommissioned roads, and mining rehabilitation sites. We are also evaluating the effectiveness of landing rehabilitation techniques on soil processes and function. A recent study, done locally, had found low survival of seed mixes in rehabilitation projects.

How are we monitoring?

Fourteen sites have been established for monitoring that include landings, aerial seeding, road decommissioning, and mining rehabilitation sites. At each site, the number of planted seedlings is counted and cover is estimated within a gridded layout. These will be monitored for 3 years post-treatment.

Key Findings (Preliminary):

- Forb and grass cover in 2014 increased greatly over that observed in 2013. In 2014, cover averaged 60% ranging from 30% to 95%.
- In 2014, on most sites the number and size of individual plants was so high that the cover saturated the small frequency grid cells.
- The most successful grasses have been slender wheatgrass, mountain brome, and blue wild rye. Slender wheatgrass and mountain brome are usually transitory species and may be replaced in future years.
- On sites that had significant litter, and/or a cryptogrammic crust, and currently have smooth brome or dense spotted knapweed there was essentially no establishment of seeded grasses.
- Native forbs included in some seeding mixes have not established well on any sites.

How will this information be used?

The project is providing project managers with suggested seed mixes and plans for rehabilitation projects. The results will be used to improve these seed mixes and methods for soil and vegetation rehabilitation.

Next steps: One final year of monitoring will occur in 2015 and then a report detailing the findings will be produced.

Reports and Resources:

- Initial re-seeding report: http://www.swcrown.org/wp-content/uploads/2014/11/Report-2013-2014-Evaluation-of-LNF-Reseeding-Sites.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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Partners:

Lolo National Forest

University of Montana

Ocular monitoring can lead to false determinations of success. Here we see what looks like revegetation success at a reclaimed mine site (Lolo NF).

Upon closer inspection there is still a lot of exposed bare ground, rock, and debris. Vegetation surveys determined canopy cover of species was around 0.5% for most seeded species except white clover, slender wheatgrass and mountain brome which ranged from 10-30% canopy cover.

Southwestern Crown Collaborative Monitoring Program

Fire Modeling

What is being monitored and why is it being monitored?

We are modeling potential fire behavior and burn probabilities for the Southwestern Crown of the Continent landscape. Two of the primary goals of the Collaborative Forest Landscape Restoration Program (CFLRP) are to reduce uncharacteristic wildfire and implement treatments that reduce forest fuels. This project will help us determine if fire behavior and fuels objectives are being met at the project and landscape scale.

How are we monitoring?

We are using the FSim (Large Fire Simulator) system to estimate burn probabilities across the entire landscape; the burn probabilities represent how often each pixel or cell burns based on thousands of simulations using different weather scenarios and ignition locations. We modeled change in burn probabilities between 2010 and 2020 (i.e., the life of CFLRP) by incorporating fuel and forest treatments planned under CFLRP. We are also using the FlamMap system to model potential fire behavior under different weather scenarios and to estimate outputs such as flame length and potential for crown fire. We modeled changes, under 97th percentile fire conditions, in fire behavior from 2010 to 2014 incorporating treatments conducted in that time period.

Key Findings: (also see maps below)

- There is little difference in burn probabilities between 2010 and 2020 with planned treatments.
- The highest burn probabilities are not in Forest Service ownership, but include private and other agency lands.
- There are also higher probabilities in areas that have burned in the last 20 years since many of these areas are dominated by grass/shrub surface fuels. However, these areas may be good candidates for modified fire suppression.
- The pre-treatment burn probabilities are already pretty low, and most of the treatments (approximately 101,000 ac projected through FY2019) are located within the footprint of lowest burn probabilities. However, although burn probabilities may be low predicted flame lengths may be high indicating the likelihood for low probability, high consequence events.
- Within areas treated between 2010 and 2014, almost all crown fire is reduced to surface fire, showing that treatments are successful under the simulated conditions (97th percentile conditions).
- However, those effects wash out at the landscape scale. In 2010, only 2% of Forest Service lands in the landscape modeled as "active crown fire", with 58% in "non-burnable" or "surface fire" (remaining 40% in "passive crown fire"). In 2014, the only change is 2% of the area predicted to burn as passive crown fire prior to treatment is now expected to burn as a surface fire.
- In 2014, predicted flame lengths within 95% of the treated area are reduced to 0-4 ft., which is the flame length under which firefighters can attack a fire on the ground. However, at the landscape scale that only translates to a 1% change of the total SW Crown area.
- Inventoried roadless and wilderness areas often offer the best opportunities for managing

wildfires for resource benefits. The Condon Mountain fire was a good example of this management strategy.
- Treatments need to be designed at an appropriate scale to change fire behavior outputs.

How will this information be used?

The FSim products from this project can be used for fire planning, specifically for response planning and for cost effectiveness modeling in conjunction with other tools (i.e., R-CAT). FlamMap products can be used for fuel treatment planning, perhaps by the Blackfoot-Swan Landscape Restoration Project (BSLRP). The project also tracks the effectiveness of implemented treatments.

Next steps: The modeling may be repeated with new data at the end of the CFLR program to determine effectiveness of treatments implemented under the program.

Reports and Resources:

- Presentation from 2015 Adaptive Management Workshop: http://www.swcrown.org/wp-content/uploads/2014/11/Landscape-Fire-Analyses.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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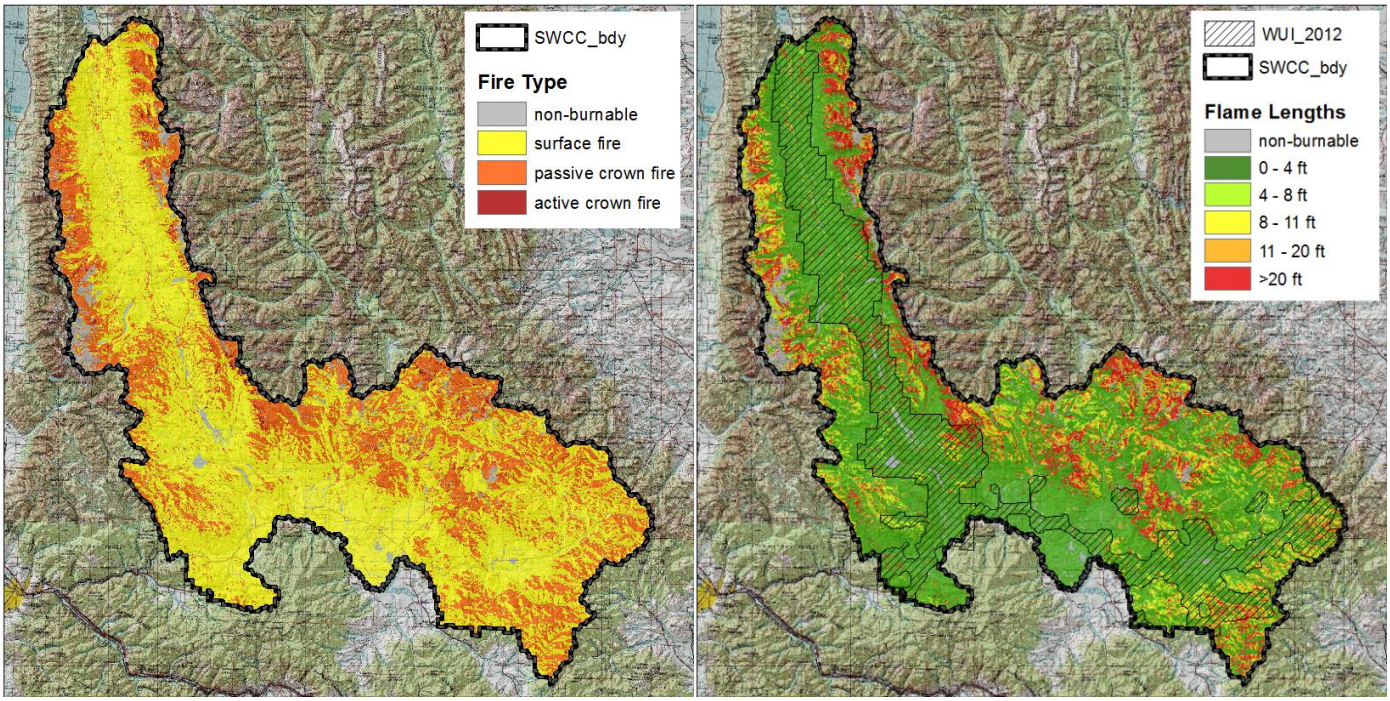
Partners:

USFS Rocky Mtn Research Station, Fire Modeling Institute

Flathead, Helena, and Lolo National Forests

USFS Region 1



Modeled fire type and flame lengths in 2010 for the SW Crown landscape.

Southwestern Crown Collaborative Monitoring Program

Herbicide Effectiveness Monitoring

What is being monitored and why is it being monitored?

We are monitoring the effectiveness of aerial herbicide treatments in reducing non-native plants and their effects on native plants. We are also monitoring the ability of native species to become established after being seeded at sites post-herbicide application.

How are we monitoring?

We have established 14 monitoring sites across the SW Crown landscape. The plots measure responses of non-native and native species abundance under multiple treatments: herbicide only, seeded (with native species) only, herbicide and seeded, and controls (no seeding or herbicide). Sites were monitored pre-treatment and up to three years post-treatment.

Key Findings from 2011-2014: (also see graphs below)

- Herbicide treatment only: Cover of non-native species decreased, on average, by 50% first year after herbicide treatment. There was a slight increase in non-native species cover in the second year after treatment. Native species cover decreased, on average, by 10% first year after herbicide treatment and showed little change in the second year.
- Seeding treatment only: Non-native species cover decreased, on average, 40% first year after seeding with native species, but showed a 50% increase in the second year. Native species cover decreased by 30% in the first year and increased by 30% the second year.
- Herbicide and seeding treatment: with herbicide followed by seeding there was a decrease in non-native cover of > 40% in the first two years post-treatment. Native cover decreased by 25% in the first year and increased by 40% the second year.
- Some native species showed a delay in response to herbicides. For example balsamroot mortality was only about 3% in first year post-herbicide, but increased to >20% in the second year (control plot showed 4% mortality in second year).
- A complementary greenhouse study showed that increasing the number of days between herbicide application and seeding improved seedling density for some native species.

How will this information be used?

This information will inform managers about the effectiveness of their aerial herbicide applications on reducing non-native species and unintended effects on native species. It could lead to recommendations on how to improve the treatment effectiveness on weeds and decrease impacts on native species.

Next steps: Year three post-treatment monitoring will occur in 2015 with a final analysis soon after.

Reports and Resources:

- 2011-2014 SW Crown Herbicide Effectiveness Monitoring Report: Coming soon.
- Wagner and Nelson. 2014. *Herbicides Can Negatively Affect Seed Performance in Native Plants*. Restoration Ecology 22(3):288-291.
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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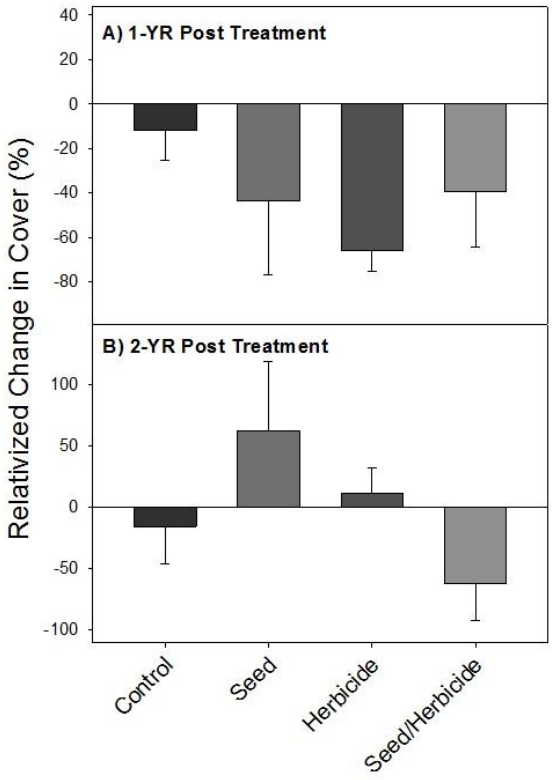
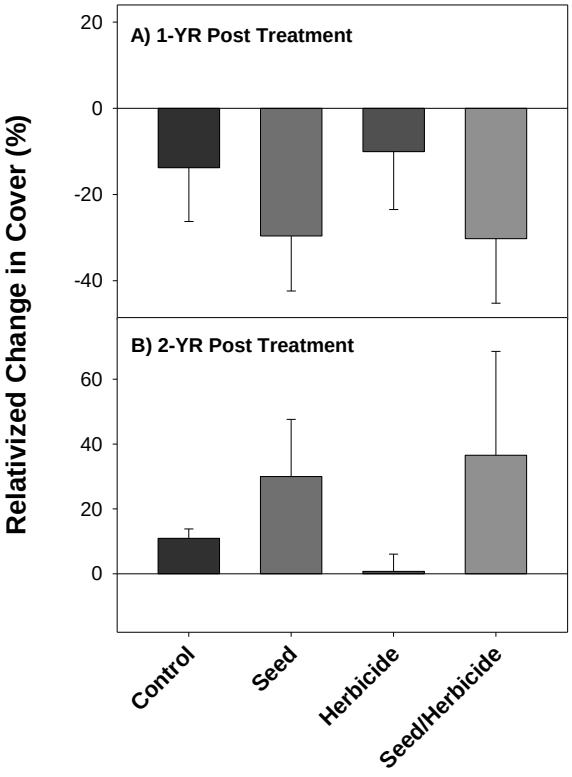
Partners:

Flathead, Helena, and Lolo National Forests

College of Forestry and Conservation, University of Montana



Non-native species cover change.



Native species cover change.

What is being monitored and why is it being monitored?

We are monitoring recovery of wildlife habitat, vegetation, and soils on decommissioned roads. There has been considerable discussion about what level of restoration is needed to provide wildlife habitat and restore soil productivity on permanently closed roads. Also, weeds are established along many roads, and it is important to ensure that any restoration efforts do not help their spread. Accordingly, we are looking at the rates of re-vegetation of native plants and non-native noxious weeds, as well as soil development, under different levels of road decommissioning treatments including abandonment, decompacting the roadbed (ripped), and fully recontouring the road. This is being undertaken in tandem with other monitoring efforts looking at the effects of roads on erosion, aquatic habitat, and economics which will give us a greater understanding of the effects of restoring roads on Forest Service lands in the Southwest Crown of the Continent region and beyond.

How are we monitoring?

We are using a series of permanent plots installed on roads before and after restoration treatments. We compare vegetation and soil recovery across roads that are "ripped" or "recontoured" to closed roads with no treatment, open roads, and reference conditions in adjacent forested areas. Remotely-triggered wildlife cameras are also placed on a subset of sampling sites. Currently, 50 sites have been sampled, pre-treatment, across the SW Crown landscape. An additional 50 sites are planned for data collection in the summer of 2015.

Key Findings:

- We have collected baseline information to gauge the existing condition on roads and adjacent reference forest conditions.
- In comparing roads to reference forest conditions, not surprisingly, all measures of vegetation and soil were higher in reference forest conditions than on open or overgrown roads.
- We identified 12 different species of trees, 28 species of shrubs or sub-shrubs growing on or adjacent to roads.
- Douglas fir and cottonwood were the most common tree species encountered on roads, and ceanothus and snowberry were the most common shrub species to recolonize a roadbed.
- Weeds were more prevalent on roads than adjacent forested areas, especially spotted knapweed. We found 11 different species of noxious weeds currently established along roads.
- The fillslope (downhill) portion of roads was more revegetated than the roadbed or cutslope (uphill) portion of a road. This is not surprising since it is not compacted and contains the original topsoil from when the road was constructed.

How will this information be used?

This project will help the Forest Service determine the effectiveness of different road treatment types and revegetation methods at reducing weed infestations and restoring vegetation, wildlife habitat, and soil development. It will also help prioritize locations and methods for future restoration efforts.

Next steps: All plots will be measured pre-treatment and year 1, year 2, and year 5 post-treatment. Pre-treatment monitoring sites have been established in several project areas: Colt Summit, Center Horse, Horseshoe West, and Poorman Creek. In future years, these sites will be resampled and new sites established on the Blackfoot Travel Plan (Helena NF) and Chilly James (Flathead NF) areas. Other sites may be identified if appropriate.

Reports and Resources:

- Presentation from 2012 Adaptive Management Workshop: http://www.swcrown.org/wp-content/uploads/2014/11/Roads-monitoring-Veg-and-Soils-Switalski.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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Partners:

Flathead, Helena, and Lolo National Forests
InRoads Consulting, Inc.
College of Forestry and Conservation, University of Montana


Sampling vegetation and soils on a road in the Horseshoe West project area, Lolo NF.

Images taken from wildlife cameras at sampling sites on closed roads.

Southwestern Crown Collaborative Monitoring Program

Carnivore Monitoring

What is being monitored and why is it being monitored?

We are monitoring the presence, abundance, and distribution of mid-size carnivores, especially **lynx, wolverine, and fisher**. More specifically, we are conducting long-term monitoring of these species across the Southwestern Crown landscape to detect changes in their distribution and abundance during implementation of the Collaborative Forest Landscape Restoration Program (CFLRP).

How are we monitoring?

We are using **winter track surveys, bait stations, and remote cameras across the 1.5 million acre Southwestern Crown landscape**. Track surveys are conducted along roads within 5 mi x 5 mi grid cells (85 grid cells with majority of area in SW Crown). Multiple bait stations are deployed within each grid cell, and remote cameras are placed at a subset of bait stations. Genetic material from hairs and scat are collected from backtracking and bait stations, and analyzed to identify species, gender, and individuals (when possible).

Key Findings from 2012-2014: (also see maps below)

- **Lynx:** Detections in 36 unique grid cells, with consistency in the number of cells with detections each year (19-21 cells per year). 18 individual lynx detected (13 males and 5 females). The limited number of females detected is a concern that we plan to focus on in the future.
- **Wolverine:** Detections in 38 unique grid cells; number of cells with detections increased over the 3 years, due in part to improved sampling techniques, but possibly also to changes in population numbers; more monitoring is needed**.** 16 individual wolverines were detected (7 males and 9 females). Long distance movements and highway crossings were observed.
- **Fisher:** No fishers have been detected during this monitoring, although the same methods have been successful at detecting fishers in other parts of the Northern Rockies.
- Other species: Track observation and genetics have also been collected for many other species including marten, bobcat, mountain lion, and wolves.
- We have developed and tested a rigorous methodology for monitoring changes in abundance and distribution over time for multiple carnivore species simultaneously; including identifying many cost efficiencies that maximize the detection of the target species.
- Track surveys have proven to be the most effective method for detecting lynx presence in a grid cell, and are often sometimes useful for collecting genetic information.
- Bait stations rarely indicate presence where we have not already detected presence via tracks. However, bait stations add insight as to abundance of lynx and wolverines within a grid cell by obtaining genetic samples that inform us about individuals and other genetic measures.
- These methods are now being used by other landowners in and around the SW Crown including the Bureau of Land Management (BLM).
- The project shows the benefits of monitoring partnerships between federal agencies and outside partners that can provide additional expertise, capacity, and funding.

How will this information be used?

Data on the distribution and relative abundance of carnivores can be used to monitor population changes over time, locate areas of potential use by these species, and identify places where improvements to habitat may be appropriate. They can also be used in effects analyses in documents completed under the National Environmental Policy Act (NEPA). The results also have the potential to inform a wide variety of regional management efforts, including (but not limited to): the development of new Forest Plans; the development of restoration projects by local collaborative groups; monitoring programs for Region 1 of the U.S. Forest Service; and management planning for these species by the U.S. Fish and Wildlife Service and Montana Fish, Wildlife & Parks.

Next steps: Surveys have continued in the winter of 2015 and these data will soon be analyzed. Additional efforts have also started or may commence in lands surrounding the SW Crown, including other parts of the Flathead National Forest and BLM lands both inside and outside the SW Crown landscape. Additionally, the Forest Service is discussing the use of our methods at a regional scale. We hope to continue monitoring through 2022, at a minimum.

Reports and Resources:

- 2012-2014 Carnivore Monitoring Progress Report: http://www.swcrown.org/wp-content/uploads/2015/01/2012-2014-SWCC-Carnivore-Monitoring-Report-Final1.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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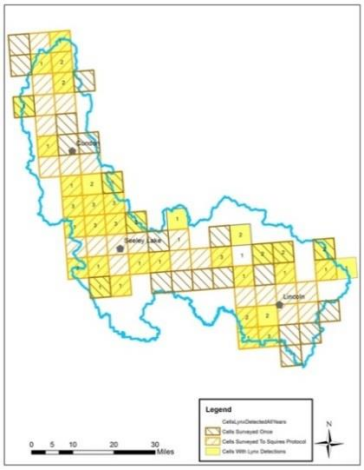
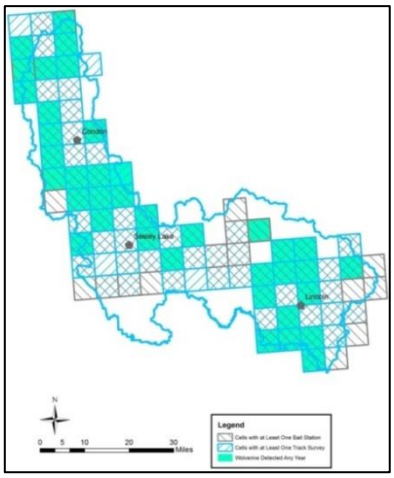
USFS Region 1
Northwest Connections
Swan Ecosystem Center
Blackfoot Challenge
University of Montana
The Wilderness Society
Bureau of Land Management
Montana Fish, Wildlife and Parks
Montana Department of Transportation
Montana Department of Natural Resources and Conservation
The Nature Conservancy
Wild Things Unlimited



Grid cells with lynx detections (yellow).



Grid cells with wolverine detections (blue).

What is being monitored and why is it being monitored?

One of the goals of the Collaborative Forest Landscape Restoration Program (CFLRP) is to improve habitat for wildlife species. We are modeling changes in habitat suitability for selected wildlife species due to vegetation treatments conducted under the CFLRP. The species chosen for monitoring include fisher, American marten, northern goshawk, flammulated owl, hairy woodpecker, and pileated woodpecker.

How are we monitoring?

We have developed habitat models based on forest characteristics that are key components of each species' relationship to its environment (see examples at bottom). Vegetation measurements (e.g., canopy cover, density of snags, ground cover) will be taken within multiple plots in each treated stand, pre- and post-treatment (years 2, 5, and 10). Vegetation measurements will then be input into the habitat models and changes through time in suitability levels determined at multiple scales.

Key Findings:

- Due to delays in treatment implementation, vegetation measurements have only been conducted pre-treatment.
- Habitat variables for fisher include: tree canopy cover, mean DBH of overstory trees, canopy cover of shrubs > 3ft, and canopy cover of spruce and true fir.
- Habitat variables for American marten include: tree canopy cover, canopy cover of spruce and true fir, percent cover of logs > 6 in diameter, average diameter of woody debris, and ecological site.
- Habitat variables for northern goshawk include: mean overstory tree height, tree canopy cover, and stand basal area.
- Habitat variables for flammulated owl include: density of snags >20in, tree canopy cover, relative stand density index, and ecological site.
- Habitat variables for pileated woodpecker include: tree canopy cover, snag density (>20in and >30in), mean tree DBH, density of stumps >3ft, and diversity of log decay classes.
- Habitat variables for hairy woodpecker include: snag density >10in, mean DBH of overstory trees, percent canopy cover, and density of snags and logs.

How will this information be used?

This project will allow us to quantify the changes to the habitat for important wildlife species and the effectiveness of restoration treatments. Future treatments may be altered to meet objectives for some wildlife species.

Next steps: We plan to re-sample vegetation in multiple project sites in 2016 and run the models. Variability in habitat variables will be estimated from the plot data to provide confidence levels.

Reports and Resources:

- Habitat Suitability Monitoring Progress Report: http://www.swcrown.org/wp-content/uploads/2014/07/CFLRP-wildlife-modeling-report-July-23-2012.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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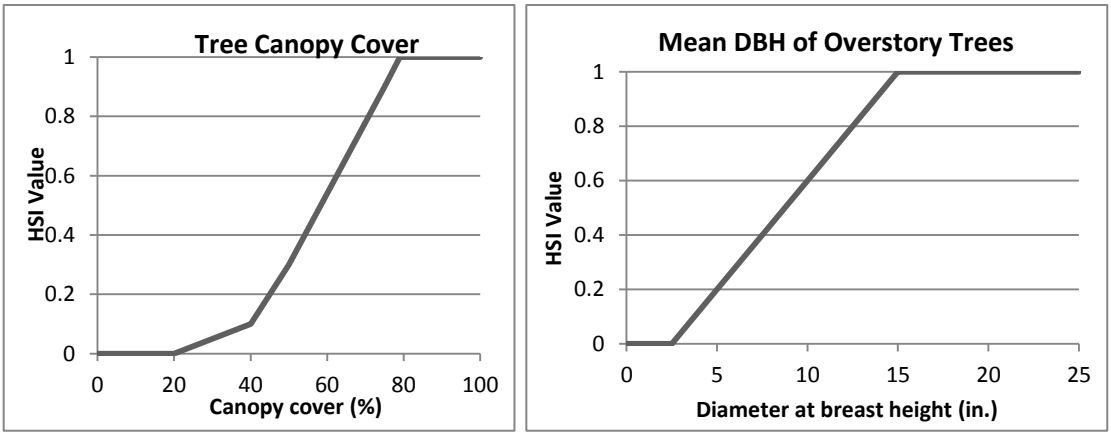
Partners:

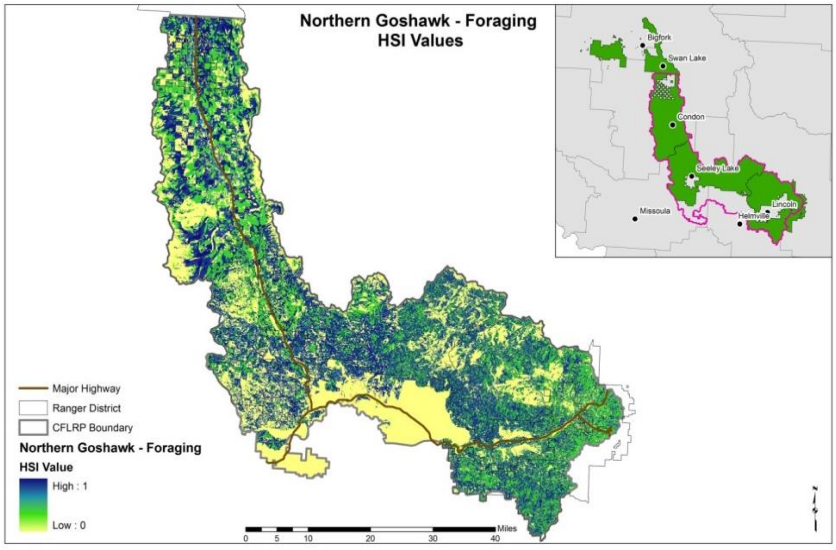
Ecosystem Management Research Institute

Flathead, Helena, and Lolo National Forests

SWCC Wildlife Working Group



Examples of the relationship between vegetation parameters and habitat suitability scores for fisher.



Example (not based on actual data) of HSI map for northern goshawk foraging habitat.

Southwestern Crown Collaborative Monitoring Program

Cutthroat Genetics Monitoring

What is being monitored and why is it being monitored?

We are monitoring population sizes and genetic purity of westslope cutthroat trout in 16 tributary streams of the Swan River. A 2010 assessment of the Swan River drainage found that westslope cutthroat trout occupy only 20% of their historic range and existed in remnant populations in scattered tributary streams. The primary cause of decline was competitive pressure from, and hybridization with, nonnative trout. In order to prioritize restoration efforts, 22 tributary streams were identified that had at least 100 individuals with known or suspected genetic purity greater than 95%. Baseline information was needed in order to verify current status, prioritize work, and monitor success of restoration efforts.

How are we monitoring?

We collected genetic material, after electrofishing, from cutthroat trout in 22 streams in 2011-2013. All fish were released alive near point of capture. Genetic samples were analyzed by the University of Montana's Flathead Biological Station for genetic purity and diversity.

Key Findings: (also see map below)

- The abundance of cutthroat trout ranged from a low of 111 1+ year-old fish (Owl Creek) to over 5,500 1+ year-old fish (Kraft Creek).
- Only 8 out of 22 populations were 100% pure.
- Nonnative brook trout had successfully colonized four populations, apparently just within the past few years.
- All but one population (Kraft Creek) had greater than 95% purity. However, the number of individuals with nonnative alleles varied widely. Some populations had very few hybrids while others contained many hybrids at low levels of hybridization.
- One population (Herrick Run) had 10-fold lower diversity than other streams and appears to suffer from inbreeding depression.
- One population (Lion Creek) had only a single individual captured and thus could not evaluate population or genetic characteristics.
- Our findings suggest that 11 out of 22 populations have very high conservation value. These populations are genetically pure or have extremely low level of inbreeding and have not been compromised by brook trout.

How will this information be used?

The information is critical to the collaborative to determine management strategies and priorities. For example, the location of a planned fish barrier was changed since the population targeted for isolation had already been invaded by non-native fish. Also, the Herrick Run population is being bolstered with individuals from Danaher Creek (South Fork Flathead River population). This work will also allow us to determine how effective management actions are over time.

Next steps: The populations will continue to be monitored with repeat sampling scheduled every five years (i.e. in 2016 and 2021).

Reports and Resources:

- Baseline Cutthroat Genetics Report (2012): http://www.swcrown.org/wp-content/uploads/2014/07/2011SwanGeneticReport.pdf and Update:
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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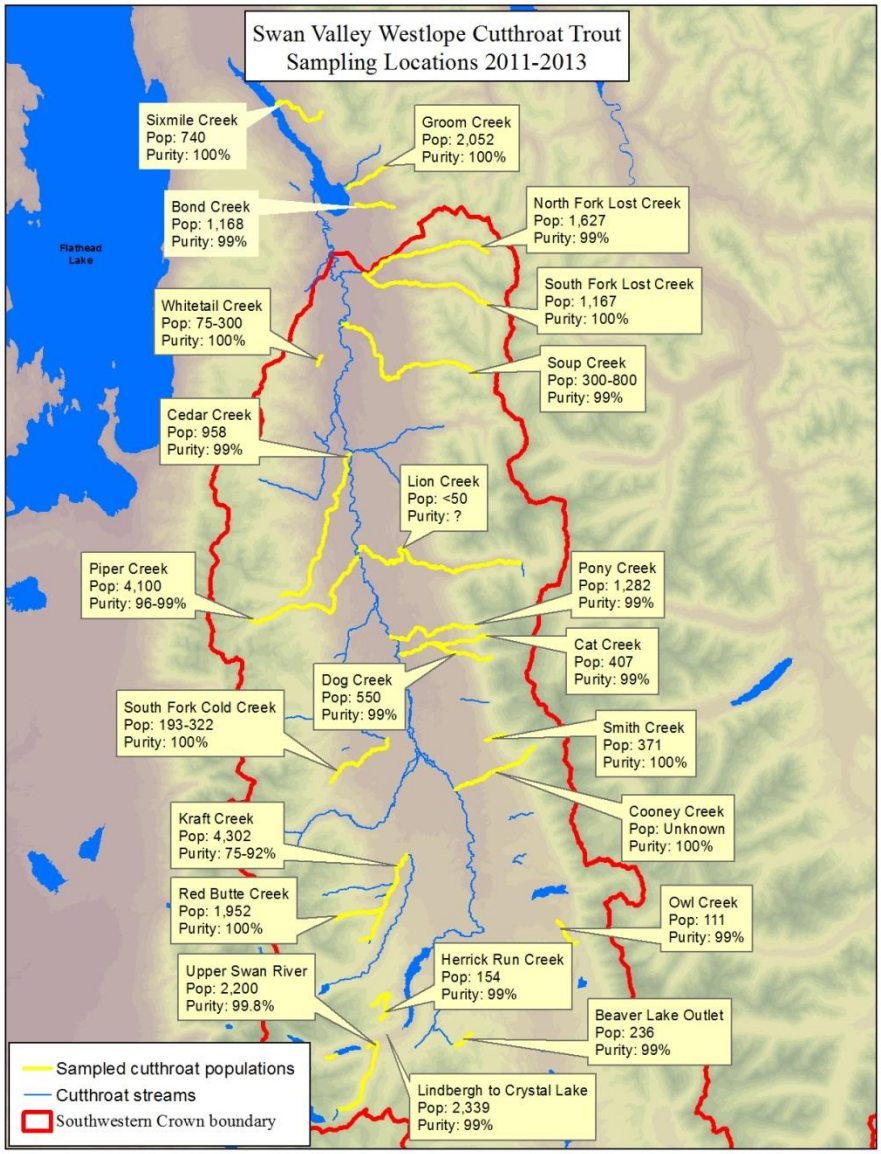

Tributary streams sampled for cutthroat trout in 2011-2013 and their estimated population sizes and genetic purity.

Southwestern Crown Collaborative Monitoring Program

Bull Trout Genetics Monitoring

What is being monitored and why is it being monitored?

We are monitoring bull trout genetic information to determine what tributaries or populations are providing recruitment into the Blackfoot River. Barriers, habitat conditions, and exotics species will all influence the success of bull trout in tributaries of the Blackfoot River. In the long-term, as we improve access, riparian conditions, and instream habitat through restoration, we hope to boost local bull trout populations so they start to provide recruitment to the Blackfoot River populations.

How are we monitoring?

Genetic information from bull trout was collected in tributaries and the mainstem of the Blackfoot and Clearwater rivers in 2012-2013. Bull trout were sampled through electrofishing and released at their site of capture after collection of a genetic sample. Individual bull trout captured in the mainstem of the Blackfoot River and in lakes in the Clearwater drainage were assigned to a tributary of origin based on genetic analysis.

Key Findings:

- Considering the tributaries to the Blackfoot and Clearwater rivers, there tended to be more divergence *between* the two drainages than between tributaries within the same drainages.
- With a few exceptions, however, there was also moderate to large levels of genetic divergence between tributaries *within* each drainage. There was more divergence among tributaries in the Clearwater than the Blackfoot.
- In general, individuals tended to assign back to the tributary from which they were collected with a score of greater than 99% and no individuals from the Blackfoot drainage were mis-assigned to the Clearwater drainage and vice versa, suggesting very limited, if any, gene flow between the drainages. The main exceptions were Copper and Snowbank Creek in the Blackfoot drainage and West Fork Clearwater, Marshall and Deer Creek in the Clearwater.
- All of the Blackfoot tributary samples except Copper and Snowbank Creek were identified as distinct groups. Only Morrell Creek was identified as a distinct group in the Clearwater drainage. All the other samples were placed in the same group. This is because of the greater amounts of genetic diversity detected within the Blackfoot than the Clearwater tributaries.
- No bull trout collected from the Blackfoot River were assigned to having originated from the North Fork Cottonwood Creek, Dunham Creek, and Poorman Creek. This suggests that these tributaries may largely, if not solely, contain resident bull trout.
- Of the drainages definitely appearing to contain migratory bull trout, the North Fork Blackfoot River appears to be by far the most important in providing fish to the Blackfoot River. Its importance, however, tends to decrease as one progresses upstream. The Copper Creek drainage appears to contribute the least and apparently contributes fish only to the upper reaches of the Blackfoot River.
- The majority (64.3%) of the fish sampled from Seeley Lake assigned to having originated from

Morrell Creek. The remaining fish assigned to either the West Fork Clearwater River (28.6%) or Deer Creek (7.1%).

- The majority (87.9%) of the fish collected from Lake Inez also assigned to the West Fork Clearwater River.
- Both the West Fork and East Fork Clearwater river drainages appeared to be important contributors of bull trout to Lake Alva.
- Although the sample size was small, the majority (85.7%) of the bull trout sampled from Rainy Lake were identified as having originated from the East Fork Clearwater River.

How will this information be used?

This work will help prioritize the locations of future stream improvement projects such as barrier placement and habitat restoration projects. It will also measure the effectiveness of completed restoration projects at improving conditions for native species.

Next steps: We will repeat the monitoring after significant restoration efforts have been implemented, probably in 2020.

Reports and Resources:

- Bull Trout Genetic Assignment Summary 2014: http://www.swcrown.org/wp-content/uploads/2014/07/Bull-Trout-Genetic-Assignment-Results.pdf
- Southwestern Crown Collaborative webpage: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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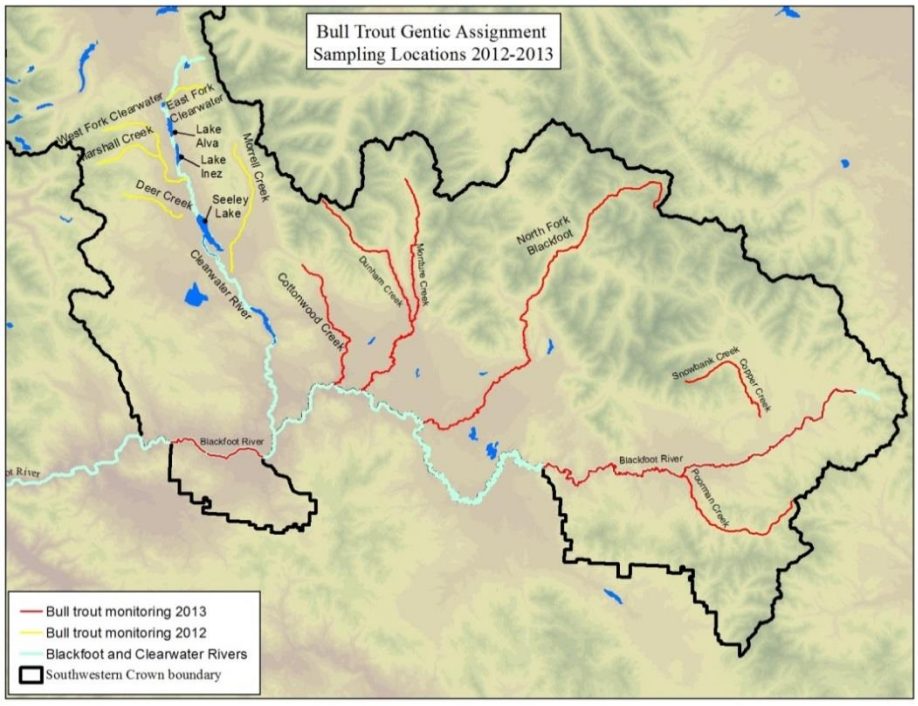
Partners:

Lolo National Forest University of Montana Montana Fish, Wildlife and Parks



Southwestern Crown Collaborative Monitoring Program

Road-Sediment Monitoring in Streams

What is being monitored and why is it being monitored?

We are monitoring (a) potential associations between forest road conditions and downstream sediment conditions, (b) the locations of road-stream sediment delivery, with detailed estimates of the quantity of sediment delivered to streams from each source, and (c) long-term changes in aquatic conditions associated with terrestrial restoration treatments in watersheds.

How are we monitoring?

We are using two tools: 1) Geomorphic Road Analysis and Inventory Program (GRAIP) and 2) PACFISH-INFISH Biological Opinion (PIBO) monitoring tools. GRAIP is a road inventory procedure that records drainage locations, landslides, and gullies and provides erosion rates based on installed sediment traps. PIBO tools measure in-stream sediment. Across six different project sites, we have surveyed 557 miles of road with GRAIP, monitored 8 sediment traps to calibrate estimates of erosion, and established 64 PIBO sampling sites - all within six watersheds within the SW Crown.

Key Findings from 2012-2014:

- Road sediment production is highly variable spatially.
- Significantly more sediment is produced per unit area (12x more in 2012-2014) on roads open to vehicles compared with roads closed to vehicles.
- Instream measures of fine sediment < 6mm and < 2mm showed that 35% and 22% of sample sites, respectively, exceeded tolerances for bull trout egg survival.
- Only 4% of roads (i.e. 22 of 557 miles) are hydrologically connected to streams and are creating sediment in the watersheds monitored. This level (4%) is considerably lower than most other landscapes measured in the Northwest. Despite limited sediment production, our data support the conceptual model linking road networks with instream sediment.
- However, the relationship between road-stream connectivity (i.e. GRAIP) measures and instream habitat (i.e. PIBO) measures are weak and highly variable. There are stronger correlations of instream measures with road density. This suggests that present day road sediment delivery is only part of the source of instream sediment.
- GRAIP is a useful tool for determining where sediment from roads is reaching streams and where mass wasting events (i.e. landslides and gullies) are occurring. This can help prioritize where restoration efforts should be focused.

How will this information be used?

Managers are using this information during planning to identify which road segments deliver sediment directly to streams, the locations of those connectivity points, how much sediment is entering the stream, and if sediment leaves the road in sufficient quantities to be detected downstream. The baseline information will be used to monitor treatment effectiveness by measuring the sediment reaching the stream and the amount observed downstream after restoration projects.

Next steps: We will continue to monitor existing sediment traps and instream sites to measure changes across years (e.g. how differences in precipitation affect sediment). We will also add new sediment traps on high traffic roads, to monitor the effect of heavy truck traffic on sediment production rates. We will revisit instream PIBO sites and roads with GRAIP after treatments (e.g. culvert replacements, road BMPs) have been implemented to measure the effectiveness of treatments.

Reports and Resources:

- Cissel et al. 2014. Southwest Crown of the Continent GRAIP Roads Assessment: Center Horse and Morrell/ Trail Project Area, Poorman Creek, and Cold Creek; Lolo, Helena, and Flathead National Forests, Montana. US Forest Service, Rocky Mountain Research Station. 113 pages: http://www.swcrown.org/wp-content/uploads/2014/11/Lolo-Helena-Flathead-NFs-SWCC-Watersheds-2014-Final-Report.pdf
- Al-Chokhachy et al. In prep. The Perceived Benefits of Forest Road Recovery: Why Context Matters.
- Rieman et al. 2014. Water quality monitoring to determine the influence of roads and road restoration on turbidity and downstream nutrients: A pilot study with citizen science. Available: www.swcrown.org/wp-content/uploads/2014/07/2014ContractCompletionWaterQualityMonitoring050114-1.pdf
- Geomorphic Roads Analysis and Inventory Package (GRAIP): Methodology: Volume 1 Data Collection Method. RMRS-GTR-280WWW http://www.treesearch.fs.fed.us/pubs/40654
- PACFISH-INFISH Biological Opinion (PIBO): http://www.fs.fed.us/biology/resources/pubs/feu/pibo/pibo_stream_sampling_protocol_2012.pdf
- Southwestern Crown Collaborative: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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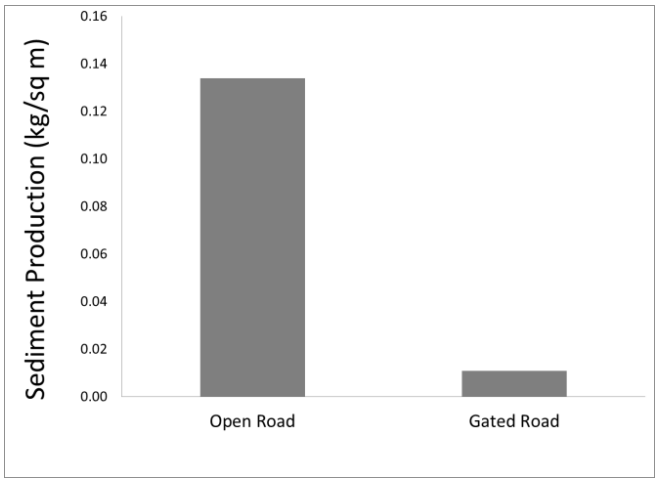
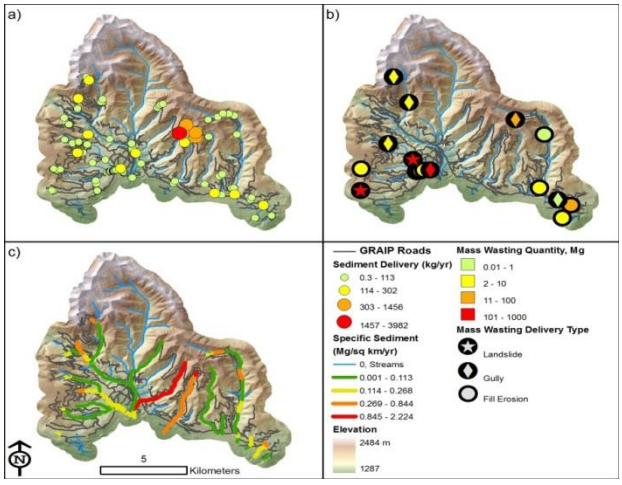
USFS Rocky Mtn Research Station: Air, Water, and Aquatics
USFS PIBO Effectiveness Monitoring Program
The Wilderness Society
Great Northern Landscape Conservation Cooperative
USFS Region 1
Clearwater Resource Council
University of Montana



Sediment from open and gated roads 2012-2014.



Example watershed and measured sediment delivery.

Southwestern Crown Collaborative Monitoring Program

Water Quality Monitoring: Pilot Project

What is being monitored and why is it being monitored?

This project focused on monitoring turbidity and major nutrients (total nitrogen and total phosphorous) in local streams. Our goals were to a) determine whether turbidity and nutrients varied across streams in the Southwestern Crown landscape and (b) whether those characteristics might be used for water quality monitoring in response to road, forest, and watershed restoration actions.

How are we monitoring?

We engaged citizen scientists in intensive monitoring of 11 streams in the Morrell-Trail and Cottonwood watersheds and less intensive work in 22 streams around the community of Seeley Lake. Students and volunteers collected water samples from March-September, with a focus during high flows from April-June. Samples were analyzed for nutrients by the Flathead Biological Station. Turbidity was measured using a turbidimeter. Flow was estimated based on continuous flow measurements taken on Morrell Creek at the base of the watershed. Three streams with a history of intensive management had previously been monitored in 1975, allowing for comparison of recovery from management through time.

Key Findings:

- Our results indicate that water quality does vary across streams and through time, can be influenced by roads and other watershed conditions, and that relatively simple and inexpensive sampling using citizen volunteers can be an effective approach to monitoring.
- Our results also indicate that recovery from the past effects of intensive forest management is occurring in some watersheds.
- **Turbidity:** Turbidity peaked during high flows in April and May. The highest turbidities were observed in Blind Canyon, Deer, Seeley, and Rice creeks, while Trail, Mountain, and Black Canyon creeks were the clearest. Maximum turbidity ranged from 2.6 NTU (Mountain and Black Canyon creeks) to 37.6 NTU in Blind Canyon Creek and over 400 NTU in Drew Creek.
- **Phosphorous (P):** Total P peaked during high flows and ranged from 13 µg/l (Trail Creek) to 39 µg/l (Blind Canyon Creek). The proposed Montana standard for P is 25 µg/l. The estimated export of total P ranged from about 20 kg, to more than 450 kg among the 11 streams. Deer Creek contributed almost two times the total P of any other stream. The export of total P by watershed area ranged from 8.66 kg/km^2 in Deer Creek to 3.86 kg/km^2 in Trail Creek.
- **Nitrogen (N):** Total N tended to peak in winter and spring before and during high flows and lowest temperatures. Peak N ranged from 152 to 481 µg/l. The proposed Montana standard is 275 µg/l. Estimated export of total N ranged from about 140 kg in Little Shanley Creek to more than 4,200 kg in Deer Creek. The relative export ranged from 37 kg/km^2 in Little Shanley Creek to 114 kg/km^2 in Seeley Creek.
- **Stream recovery**: The estimated export of total P from Deer Creek in 2013 was about 62% of that in 1975, while total N was about 31%. The estimated export of total P in Seeley Creek in

2013 was more than twice as high as that in 1975, while total N was slightly lower. In Rice Creek, both P and N appeared to be lower in 2013, but sampling effort in 1975 was much less.

- Surprisingly, there were no apparent associations between GRAIP-Lite estimated sediment delivery and water quality parameters (Total P, Total N, Turbidity) for the sampled streams.
- Volunteers collected and delivered samples on a regular and timely basis. Volunteers contributed 180 hours of time and more than 1,900 miles of personal vehicle mileage. At accepted in-kind rates ($20/hr; $0.50/mile) that represents more than $4,500 of cost savings for the project. This does not include time contributed for coordinating the volunteers.

How will this information be used?

Managers now know that watersheds can improve and changes can be measured over time. For example, road closures and dramatically reduced forest harvest activity in the Deer Creek watershed have had a considerable effect on nutrient loading to downstream lakes. This project also showed that citizen scientists can effectively monitor water quality. A small follow on study showed that roads can directly influence water quality but also showed that tools such as GRAIP-lite may not answer all questions about the effects of road restoration on water quality.

Next steps: Stream monitoring will continue with students at the Morrell Creek site and has been expanded to 3 other stream sites with local schools in the landscape (Lincoln, Ovando, and Condon). At this point, there are no plans to repeat or expand the wider stream water quality sampling.

Reports and Resources:

- Rieman et al. 2014. Water quality monitoring to determine the influence of roads and road restoration on turbidity and downstream nutrients: A pilot study with citizen science. www.swcrown.org/wp-content/uploads/2014/07/2014ContractCompletionWaterQualityMonitoring050114-1.pdf
- Addendum to report: http://www.swcrown.org/wp-content/uploads/2014/11/Addendum-to-Water-Quality-Report-Final.pdf
- Southwestern Crown Collaborative: http://www.swcrown.org/
- USFS Collaborative Forest Landscape Restoration Program: http://www.fs.fed.us/restoration/CFLRP/

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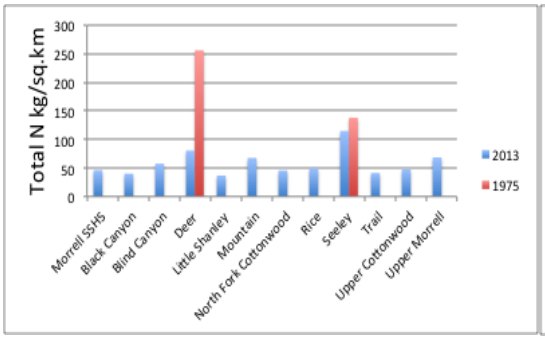
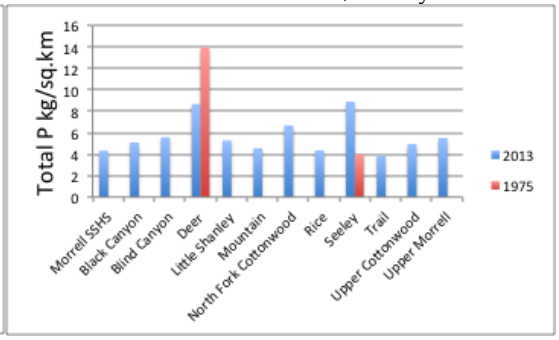


Total nitrogen by stream.



Total phosphorous by stream.