GETTING BACK TO FIRE SUMÉŜ:

INCORPORATING TRADITIONAL KNOWLEDGE INTO FUELS REDUCTION TREATMENTS

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Monique D. Wynecoop

Major Professor: Penelope Morgan, Ph.D.
Committee Members: Eva Strand, Ph.D., Travis Paveglio, Ph.D.
Department Administrator: Randy Brooks, Ph.D.

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AUTHORIZATION TO SUBMIT THESIS

This thesis of Monique Dora Wynecoop, submitted for the degree of Master of Science with a major in Natural Resources and titled "GETTING BACK TO FIRE SUMÉŜ: INCORPORATING TRADITIONAL KNOWLEDGE INTO FUELS REDUCTION TREATMENTS," has been reviewed in final form. Permission, as indicated by the signatures and dates given below, is now granted to submit final copies to the College of Graduate Studies for approval.

Major Professor: ____Date______________
Penelope Morgan, Ph.D.

Committee Members: ____Date______________
Eva Strand, Ph.D.

____Date______________
Travis Paveglio, Ph.D.

Department Administrator: ____Date______________
Randy Brooks, Ph.D.

ABSTRACT

Defining fuel treatment effectiveness is challenging in tribal ancestral lands managed for multiple use. We sampled during and one year after the 2015 North Star Fire, which burned 88,221 ha (218,000 ac) of the Confederated Colville Tribal (CCT) ancestral territory. Participatory GIS was used to understand CCT member views regarding the location and effectiveness of fuel treatments within their ancestral territory and also within the Colville National Forest boundary. To help address CCT comments regarding fire effects on cultural plants, we assessed the understory plant species abundance, richness, and diversity within areas treated and untreated prior to being burned by the North Star Fire. The majority of PGIS comments regarding fire effects were supported by our post-fire monitoring results. PGIS comments were organized into management recommendations and desired outcomes. Integrating Traditional Knowledge can improve fuel treatments effectiveness in ongoing adaptive management of forests as social-ecological systems.

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E. Strand advised on analysis methods. F. Sánchez-Trigueros, A. Watson, and C. Watt assisted with sampling protocol and methods for the PGIS and F. Sánchez-Trigueros, C. Watt, P. Morgan, L. Wynecoop, C. Minerich, and A. Tomayko assisted with field sampling.

DEDICATION

Professor Penelope Morgan for her mentorship, infectious positive energy, and belief in me and my project from the very beginning.

To my loving husband, Luke Wynecoop, worked as a seasonal wildland firefighter and also picked up the slack with the kids and farm while I was working on my thesis. He was my volunteer field technician and lookout while collecting data ahead of the North Star Fire. He is my rock and has taken on many roles in support of my research, such as providing local tribal knowledge as a Spokane Tribal Member, and giving me valuable feedback on my ideas.

To our young children Clayton, Oceana, and baby #3 on the way, for their love, support, and sacrifice during this crazy journey. This work is done for them, as well as for all indigenous people and future generations in hope that they will feel empowered to speak up for their right to protect and manage their ancestral lands and waters for their future and for all future generations.

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INTRODUCTION

Suméŝ (pronounced "Su-mesh") is an Interior Salish word used by the Confederated Colville Tribes to describe spirit power. Traditionally, those who manage fire hold a great responsibility, because they have the suméŝ to manage the landscape that sustains and provides for their tribe (Boyd 1999). The Spokane and Confederated Colville Tribes (CCT) of northeastern Washington have long valued fire as medicine for the land, which is why the role of fire management was historically an honor held by medicine men and women within the tribe. Since the establishment of reservation borders and the removal of the CCT and fire from their ancestral territories in the late 1800's, times have changed but the culture and paradigm remain for the tribal people. The social and ecological complexity of modern landscapes requires that fire managers and scientists develop multi-disciplinary approaches that allow for stakeholder input while also maintaining trust and protecting the confidentiality of local knowledge when developing effective fuel treatments and managing wildfire (Gunderson *et al*. 2011).

Since 1907, the Colville National Forest of northeastern Washington has been managing natural resources within the ancestral territories of the Spokane, Kalispell, and Confederated Colville Tribes. For countless prior generations, these tribes managed their traditional hunting, gathering, and prayer sites with locally adapted fuels reduction techniques. Such techniques have perpetuated the use of those locations and increased those areas' resilience and resistance to large fire events, thus creating social-ecological ecosystems. Many forests of the western United States that were thought to be shaped by wildfire have been found to be influenced more by intentional burning by indigenous people of that landscape (Kimmerer and Lake 2001).

Traditional knowledge of the local tribes is not routinely incorporated into fuels treatments on the Colville National Forest, yet this could aid planning, implementing, and assessing fuel treatment effectiveness. There are culturally significant plants and places that could be managed with fire off the reservation on the Colville National Forest. Traditional knowledge about prescribed fire and other fuels reduction tactics could enhance efforts to reduce hazardous fuels while also addressing local tribal and non-tribal natural resource needs by identifying the most suitable techniques, locations, and conditions under which to implement prescribed burns. However, protecting and maintaining the confidentiality and trust of the tribes is a barrier to integrating traditional knowledge into management.

Historic Perspective of the North Half

The CCT is comprised of descendants from twelve tribes and their bands, including the Colville, the Nespelem, the Sanpoil, the Lake, the Palus, the Wenatchi, the Chelan, the Entiat, the Methow, the southern Okanogan, the Moses Columbia, and the Nez Perce of Chief Joseph's Bands. These twelve tribes had ancestral territories that congregated around river systems that run through Washington, Idaho, Oregon and British Columbia (CCT 2017). Many of the local tribes of northeastern Washington were confined to a 1,214,100 ha (3,000,000 ac) reservation in 1872, now known as the Colville Reservation. Soon after, another executive order by President Grant reduced the reservation by half to 56,660 ha (1,400,000 ac) without any consultation with the tribes impacted (CCT 2017). In 1892, the northern half of the reservation that was originally part of the Confederated Colville Tribes' 1872 reservation boundary was ceded to the United States by an act of Congress (Figure 1). The "North Half", as it is called by the CCT, is known by the non-native community as the western Colville National Forest landscape, which lies west of the Columbia River and east of the Kettle Crest. Through treaties with the U.S. Government, leaders of the Colville Tribe made sure that the tribe reserved their rights to hunt, fish and gather within the North Half in perpetuity (CCT 2016).

Restoring Resilience of Forests to Future Changes

Ecosystem processes such as fire are complex and span beyond jurisdictional boundaries. The traditional lifestyle of the CCT has historically extended far beyond what is now the reservation boundary to various hunting, fishing, trading, and praying sites (Figure 2). In order to perpetuate cultural knowledge and traditional lifestyles for future generations, tribes such as the CCT are striving for improved access and co-management of their ancestral homelands outside the reservation.

In order to address the risks facing valued resources outside of their jurisdiction, indigenous people around the world are becoming more determined to protect and reassert their right to co-manage resources outside their current jurisdictional boundaries (Senos *et al*. 2006; Salick and Byg 2007; Green and Raygorodetsky 2010; Voggesser *et al*. 2013). The need to support and develop sustainable lifestyles that can readily adapt to landscape-scale disturbances such as fire, as well as global changes such as climate change, is not just a tribal one. Local communities, such as those that border the Colville National Forest, depend on the natural resources that the forest provides. The neighboring communities of Republic and Kettle Falls, WA have economies that are heavily influenced by fire and its influence on hunting, logging, recreation, and commercial and private mushroom and berry harvest.

Multi-jurisdictional management of fire-prone landscapes is increasingly important, in the face of large fires, fuel treatments, or other management practices that affect the abundance of plants and other culturally significant resources (DellaSala *et al*. 2003, Agee and Skinner 2005, Swanson and Gilgert 2009). Particularly, mid-elevation mixed-severity fire regimes such as those found on the Colville National Forest are poorly understood and therefore local research is needed for communities and agencies to adapt fuels reduction strategies to regional and climate-driven complexities (Schoennagel *et al*. 2004, Perry *et al*. 2011, Hessburg *et al*. 2016) or to restore the integrity of forests (Hessburg *et al*. 2015). In order to protect ecosystems and traditional lifestyles in the wake large wildfires, there needs to be a certain level of trust and a strong communication link shared between scientists, managers, and local communities so that forestry and fuels prescriptions are not only scientifically sound but also culturally relevant to the local communities (Lake *et al*. 2017). According to Hessburg *et al*. (2015), in order for treatment prescriptions to address climate change and sustain social-ecological systems, they need to be scientifically grounded and focus on regional and local scales that will help promote habitat connectivity and resiliency to disturbance for native terrestrial and aquatic species.

Incorporating Traditional Knowledge into Fuels Treatments

Since 2000, when the National Fire Plan was developed, there has been an increase in the amount of understory fuels reduction treatments conducted in forests and rangelands, totaling 7 million ha on U.S. federally managed lands between 2001 and 2015 (USDA 2014), with the aim of restoring healthy ecosystems and to reduce hazardous fuel loads (Lentile *et al*. 2007, Schoennagel *et al*. 2017). Though mechanical treatments and prescribed burning are both effective for reducing fuels and lowering the intensity of subsequent fires, the combination of mechanical thinning and prescribed burning has been identified as the most effective means of reducing fuel loadings and crown-fire potential long-term (Finney et al. 2005, Schwilk *et al*.

2009, Stephens *et al*. 2009, Prichard *et al*. 2010, Hudak *et al.* 2011, Arkle *et al.* 2012, Fulé *et al*. 2012). On the Colville National Forest, prescribed burn and thinning projects have been widely implemented as they are considered highly successful by many forest managers. Monitoring the effectiveness of fuels reduction treatments is a vital step towards the successful management of our forests for ecosystem resilience.

While many studies have evaluated fuel treatment effectiveness in terms of fire behavior and fire suppression (e.g., Hudak *et al.* 2011, Safford *et al.* 2012), and many others have evaluated how plants respond to fuels treatments (e.g., Metlen *et al.* 2004, Gundale *et al*. 2005, Youngblood *et al*. 2005, Kane *et al.* 2010), few have evaluated how fuel treatments alter plant response to wildfire. Even fewer studies have looked at how wildfire is managed in indigenous communities (Carrol *et al*. 2010, Christiansen 2015) or have incorporated Traditional Knowledge (TK) regarding cultural plants and their response to fire (Kimmerer and Lake 2001) for comprehensive management of socio-ecological systems. The term socio-ecological system (SESs), explains that ecosystems and society are often not mutually exclusive and are influenced by each other and their multiple subsystems, which can include everything from resource systems, resources units, resource users, and the governance system (Ostrom 2009). Fire and fuels management that integrates Traditional Knowledge (TK) with other social values will potentially be more sustainable within forests, such as the CNF, that have long been adapted to human-ignited fires. Therefore, cultural values must be part of evaluating fuel treatment effectiveness. Desired outcomes and identified values at risk can vary based on the agency and the dominant culture within the agency. Because of these cultural differences, the USFS and the CCT may judge fuel treatment location and effects differently.

To address these differences, we solicited the help of the Rocky Mountain Research Station, their partners, and their Mapping Meanings tool (Map-Me, http://map-me.org) to help us develop a participatory GIS exercise that will provide an output that can be overlaid with Forest Service fuels reduction treatment plans. The Rocky Mountain Research Station has had previous experiences using the Map-Me tool to help collaborative landscape management efforts of the Confederated Salish and Kootenai Tribes of the Flathead Reservation, Jemez Pueblo, and the Santa Clara Pueblo (McBride *et al*. 2017). The PGIS exercise, combined with fuels monitoring plots, were funded by and incorporated into the Colville National Forest Collaborative Forest Landscape Restoration Program (CFLRP) (fs.fed.us/restoration/CFLRP) monitoring program as a socio-economic monitoring question that will help address how USFS fuels treatments are impacting tribal values.

The planned outcome of this combined monitoring and consultation program is that the Colville National Forest and the Confederated Colville Tribes will use these maps and feedback produced to help determine if the Forest Service is meeting their Federal Trust responsibility as stewards of the CCT ancestral homelands, and to help determine how to better target and implement fuels reduction treatments in areas of concern to the Confederated Colville Tribes.

Research Goal and Objectives

Our research goal is to determine the effects of wildfire in areas with and without prior fuel treatments on understory vegetation within the Collaborative Forest Landscape Restoration Project (CFLRP) area and to address the implications that this may have for cultural practices of the Colville Tribe that occur within the North Half, particularly culturally important, edible, and medicinal plants. Our objectives were to 1) determine how the understory vegetation within the project area is responding to the North Star Fire within areas with and without prior broadcast burning and mechanical thinning treatments, and 2) determine where USFS treatment areas and mapped cultural values of tribal collaborators overlap and how the USFS can better manage these treatment areas to promote the values of interest to the CCT within in the CNF CFLRP project area aka the 'North Half'. Our hypotheses were that understory plant species richness and Shannon-Wiener diversity, as well as the abundance of culturally significant plants will increase post-fire more within fuels treatments than in areas not treated prior to being burned by the 2015 North Star Fire.

We hope the results from this project will be used by USFS managers in designing fuel treatments and for improving collaboration and trust between the USFS and local tribes that will help protect and promote tribal cultural use of their traditional hunting, fishing, and gathering areas. Further, we hope to demonstrate this approach as feasible for supporting management of social-ecological systems.

METHODS

Study Area

This research took place on the western side of the Colville National Forest bordering the Tonasket Ranger District of the Okanogan-Wenatchee National Forest within a Collaborative Forest Landscape Restoration Project (CFLRP) area called Northeastern Washington (NEW) Forest Vision 2020 project area (Figure 3). The area is commonly referred to by the Confederated Colville Tribal (CCT) community as the 'North Half'. The CFLRP area comprises 370,807 ha (916,284 ac) south of the Canadian border, west of the Columbia River, as far as the eastern border of the Colville National Forest, and as far south as the northern boundary of the CCT Reservation. The CFLRP offers a unique opportunity provided by national funding and guidance to foster collaborative relationships between local agencies and communities.

Regional Vegetation and Climate

The dominant forest type of the North Half is lodgepole pine (*Pinus contorta*) and mixed conifer (USDA, 2014). The elevation of the North Half ranges from 488 m (1601 ft) along the Kettle River to around 1,859 m (6099 ft) along the highest ridge (USDA 2014). According to Williams *et al*. (1995), the project area historically had open forest stands with low understory vegetation that was well adapted to frequent surface fires and there are many mature trees on the Colville National Forest that have charcoal and fire scars reflecting that history. Prior to the designation of the CCT Reservation boundary in 1887, light surface fires were common, with fires at 0-35 year intervals in dry mixed-conifer sites and 35-100 year intervals for moist sites such as wetlands, meadows, aspen stands, and riparian areas

(Williams *et al*. 1995, Stine *et al*. 2014). Following 1887, fire suppression and the removal of human-ignited fire from the North Half led to dense, thick stands that are susceptible to disease and infestation and after death are more prone to crown fire (McCullough *et al.* 1998).

Vegetation Response to Wildfire with or without Prior Fuel Treatments

The primary focus of this research project is understory vegetation response to wildfire within areas that underwent a combination of prescribed burning and mechanical thinning within the past decade, and areas that received no treatment within the past decade. The plots were placed within past USFS fuels treatments that were within the boundary of the North Star Fire, which started around August 13th, 2015 about 40 km (25 mi) north of the Grand Coulee Dam. The North Star Fire grew to 88,277 ha (218,000 ac) by the time it had been announced 96 % contained in late October, 7284 ha (18,000 ac) of which occurred on the Colville National Forest (NWCG 2015).

We collected data from 15 paired plots that were treated or untreated, within mixed-conifer forest, and shared similar topography, slope, and aspect. Ten of those plots were sampled within areas that were thinned and burned prior to the wildfire in August 2015 and revisited post-wildfire in May 2016. Five pairs of plots were sampled in May 2016 with each pair established in treated and untreated areas that were otherwise similar with respect to aspect, elevation, slope, slope position, and forest type.

We collected pre-wildfire field data during August 2015 (while the fire was still burning) using a rapid response protocol and wildfire safety standards similar to those outlined by Lentile e*t al*. (2007). Due to safety concerns, the field crew had to be fire qualified with a lookout, and coordinate closely with the team managing the response to the North Star Fire.

Plots had to be visible from the road, and field technicians had to be in radio contact and ready for a quick evacuation at short notice. Within these constraints, plots were placed randomly. The exact plot locations were revisited post-wildfire in May 2016. In May 2016, we collected data from paired plots in sites nearby that were and were not treated prior to the North Star Fire.

All plot sites had to meet basic criteria in order to be sampled. They had to be on land managed by the U.S. Forest Service land within the boundary of the North Star Fire. All pairs had similar slope (15-25 %) and aspect (all were generally south-facing), with similar elevation (ranging from 1128 m to 1295 m elevation). For each plot pair, one of the plots had to be from areas with fuel treatments occurring during the previous 10 years. All plots were randomly located and they had to be at least 50 meters (164 ft) from any skid trails, roads, or landings.

We adapted the fire effectiveness monitoring framework and Before After Control Impact (BACI) design that was already being used as a part of the NEW Vision 2020 monitoring program. We used FIREMON methods (Lutes *et al*. 2006), including the Plot Description (PD), Tree Data (TD), Species Composition (SC), and Microplot Photoload and Fuel Data Forms (Appendix 1). On each plot, the understory plant information (species, ocular estimate of percent canopy cover, and height), surface fuels (1, 10, 100 hour fuels), ground cover (ocular estimate of percent cover bare soil, rock, wood, charred ground, gravel, litter and duff, moss and lichen, and ash) were collected within five 2 x 2 m (6.6 x 6.6 ft) microplots (Figure 4). Ground cover and tree data (diameter at breast height (DBH), height, and health) were also collected within the 5.64 m (37.2 ft) diameter plot. We used the photo load sampling technique developed by Keane and Dickinson (2007) to determine fuel loading.

Vegetation Analysis

The species data used for the analysis were comprised of the understory plant species that were found in at least three of the 30 total plots (Appendix 2). The common and scientific names were taken from the USDA Plants database (https://plants.usda.gov). The qualitative variables include treatment category and pairs. Treatment categories were defined as pre- (T) and post-wildfire (TB) pairs in treated (mechanically thinned and prescribed burned) areas and treated (TB) vs. untreated (B) pairs burned by wildfire.

Data were first graphed as a species-area curve and tested for adequate sample size (number of plots) within PC-ORD (McCune and Grace 2002). We used the mean total percent cover of bare soil, charred ground, and ash to described the burn severity of each plot, similar to the approach of Parson *et al.* (2010), which define burn severity as fire effects on ground surface characteristics such as char depth, organic matter loss, and altered color and structure. Morgan *et al*. (2014) define burn severity is an indicator of the degree of ecological change due to fire. Though we did not measure char depth or water repellency, we recorded the percent cover of char (charred ground) and the absence of organic matter (bare soil and ash) to determine the degree of fire severity within the plots. Differences in burn severity (total percent cover bare soil, charred ground, and ash), fuel loads between treatments, abundance of selected species, species richness, and Shannon-Wiener Diversity Index (Shannon 1948) were evaluated for paired plots with a blocked multi-response permutation procedure (MRBP) with a Euclidean distance measure in PC-ORD, with treatment type being the grouping variable and pair being the blocking variable. MRBP does not require assumption of normal distribution of variables (McCune and Grace 2002). Fire severity, fuel loading, Species richness, Shannon-Wiener Diversity Index, and species abundance data were graphed in boxplots using PC-ORD. Results are interpreted via the A statistic of agreement and the *P*-value. The A statistic is a measure of agreement between groups, where A = 1 for complete within-group homogeneity; A = 0 when the heterogeneity within groups are equal to the expectation; and A < 0 if there is less agreement within groups than expected by chance (McCune and Grace 2002). The *P*-value represents the probability that there is no difference between groups. In all analyses we used P = 0.1 to determine statistical significance.

We analyzed the percent canopy cover of six plants (Table 1) chosen based on their commonly known edible and/or medicinal uses (Kershaw 2000), to demonstrate how to address questions and comments presented by participants of the PGIS exercise regarding impacts of fuels treatments on cultural plants and materials. For each of those six plant species, the percent canopy cover was compared for plot pairs using MRBP with a Euclidean distance measure in PC-ORD then graphed in a boxplot using PC-ORD.

Integrating Cultural Values into Fuels Reduction Treatments

Map-Me is an online public PGIS program designed to collect online participatory mapping and comments. It is a user-friendly computer-based geospatial interface combined with a spray-can tool that allows users to map values and concerns on a landscape in a "fuzzy" way so that the specific location of those values aren't given. Due to the program's ability to protect sensitive information, confidentiality of participants, and tribal ownership of the data, we solicited the help of the Rocky Mountain Research Station and their Map-Me PGIS program to help the USFS and the CCT collaboratively address concerns regarding USFS management practices and their locations within the North Half. The appeal of the Map-Me program is that the raw information is not connected to a Forest Service Database and is not subject to the Freedom of Information Act. The Confederated Colville Tribes own the information collected from the Map-Me exercise and any request to use the information needs to go through an approval process with the CCT. Without such a safeguard of the CCT's sensitive information, this project could not exist.

Through the Map-Me program, tribal participants voiced their views regarding three categories of Forest Service fuels reduction treatments (mechanical thinning, prescribed burning, and wildfire) within the North Half of the original Colville Reservation. Our PGIS exercise had four main goals:

1. To determine the impacts of the commonly practiced fuels reduction strategies on the cultural practices of the Confederated Tribes of the Colville Reservation. We used the cultural practices listed in the CCT's recent Integrated Resource Management Plan (CCT 2015), so that the results and terms would be readily related by the tribe to those that they are already using for similar studies. These use categories are hunting, fishing, gathering of plants and other natural resources, gathering of firewood, and the use of off-road vehicles for the purpose of participating in their cultural practices.
2. To map where participants feel the fuels treatments should be applied and how (if at all) they feel the methods should be modified.
3. To map where the participants feel the fuels treatments should be avoided and how (if at all) they feel the methods should be modified.
4. To make comparisons between the response of participants and the planned treatments or lack of treatments within the areas they mentioned, wildfire history, fire regime history, land cover, and land use.

The three types of fuels reduction treatments we discussed in the PGIS exercise were: 1) Mechanical thinning, including thinning of the understory by mastication of vegetation, 2) Prescribed fire, in which fire is applied to the landscape under specific weather and fuel conditions to accomplish specific management objectives such as fuels reduction, and 3) Managing naturally occurring wildfires for resource benefit. Sometimes it is possible to use natural and unnatural fuel breaks to practice indirect fire suppression strategies, which allow the fire to reduce fuels in the understory and reduces the impact of suppression strategies on the ecosystem, and results in less exposure of fire fighters to hazards.

The Map-Me PGIS exercise consisted of a demographic questionnaire (Appendix 3) followed by a fuels treatment questionnaire (thematic module) and then mapping exercise that allowed the participant to explain feelings or concerns related to what they put on the map (multimodal module) (see Appendix 4). The thematic module allows participants to describe in detail how each treatment type impacts each of their cultural uses of the North Half. The multimodal module allows the participants to map where they think each method of treatment should and should not be placed within the North Half.

We used the thematic module to solicit feedback from CCT participants during the Fall of 2015. Prior to getting permission to conduct the Mapping Meanings PGIS exercise with tribal members, descendants, and employees, we presented our proposal to the Colville Tribe Natural Resource Committee, and then submitted a research application that was approved by the Tribal Culture Committee and finally the Colville Tribal Council. The presentation to the Tribal Natural Resource Committee had three main goals: 1) to explain the primary reason for requesting to do the study and how it will benefit the Colville Tribal Community; 2) to get official approval to move forward with the study; and 3) to get a list of recommended participants, an estimate of number of expected participants, and ideas of how to get further CCT Tribal Member and Descendent participation in the PGIS exercise.

Participants

The tribal participants included all willing participants that work for the Colville Tribe and for the BIA and all willing CCT tribal members and descendants. We targeted a diverse representation from different management or senior roles in cultural and natural resources management of the CCT and the BIA. Most of the participants were employees from the BIA or CCT that worked in natural resources programs such as Forestry, Fish & Wildlife, Parks & Recreation, Environmental Trust, Mount Tolman Fire Control Station, Law Enforcement Office, and the Culture/History Department (Appendix 1). We counted heavily upon Chasity Watt (Colville Indian Agency and Bureau of Indian Affairs employee) with her local and professional knowledge to solicit participation from knowledgeable community members and elders. We were able to meet with them at the BIA or Tribal offices or at the tribal community centers and assist them if they had any technical issues or questions. There was no time or word limit for typed responses, and depending on how much someone wanted to write, the entire PGIS exercise took anywhere from 30 minutes to three hours. We had 40 participants agree to take part in the scoping group during our visit from November 30th-December 3rd, 2015. Of those 40 participants, 37 completed the exercise.

Data Sources

GIS data of fuel treatment locations and types that have been accomplished and maps of project area and wildfire perimeters were obtained from the USFS Colville National Forest GIS database.

PGIS Analysis

In order to facilitate the incorporation of traditional knowledge into USFS fuels reduction treatments, we produced the final tessellated maps of locations where the CCT participants would like to see more fuels reduction treatments and where fuels reduction treatments should be avoided. To accomplish this, we conducted a geospatial analysis of the pilot study data and responses using GRASS GIS and ad hoc scripting in R, Python, and Unix shell coding. The heat maps and comments provided by participants were then used to assess whether fuels treatments have been meeting CCT needs. The maps will be used to make comparisons to current planned projects and to help make recommendations on how to tailor future fuels treatments and wildfires within the North Half to address identified CCT needs and concerns.

The PGIS comments were organized into perceived impacts of treatments on gathering of cultural plants, management recommendations, and desired outcome using data-driven coding techniques outlined by Boyatzis (1998) and DeCuir-Gunby *et al*. (2011) and then organized in a table (Table 2). A qualitative content analysis was used to graph the information based on how often each theme was mentioned and how often management recommendations were mentioned.

To develop the codebook for the PGIS comments: 1) Comments were summarized into theme and description of theme in an excel spreadsheet; 2) Summarized comments were then separated into topics; 3) Common themes were then identified within the topics and arranged into perceived impact and desired outcome of treatment method in order for answers to be the most useful for resource managers; 4) The interobserver agreement of the codes were tested by comparing answers with the answers of two reviewers (a fire ecologist and a fire/social-scientist) that was otherwise not involved with the interviews and then using the answers to calculate the Cohen's kappa statistic, which uses a scale of -1 to 1, where complete agreement between reviewers would equal 1, chance agreement would equal 0, and potential systematic disagreement would be in the negative values (Viera and Garrett 2005, Cohen *et al*. 2013).

The codes were also reviewed by the authors of this paper to ensure that the codes developed would be culturally sensitive to the PGIS participants, were consistent with topics discussed, and were applicable to common terms used in fire ecology and social science fields.

Comparisons were made between perceived impact and desired outcomes identified within PGIS responses and what was found through analysis of the vegetation data to help determine treatment effectiveness. These comparisons are descriptive and qualitative.

RESULTS

Fire effects, Vegetation, and Fuels Response

Wildfire burn severity was significantly greater overall within the B than TB plots, and also within TB than T plots, as indicated by fractional cover of bare soil, charred ground, and ash (Figure 5).

The wildfire significantly reduced 1-, 10-, and 100- hour timelag fuels within T and TB, as well as within TB and B plots (Figure 6). The error bars suggest more variability in T than in TB plots, and also within TB than in B plots.

We observed significantly higher species richness within TB plots than within the T plots (Figure 7). In contrast, species richness was not significantly different for TB plots compared to the B plots (Figures 8). We observed significantly higher understory plant species diversity within TB plots than within T plots and also within B plots than within TB plots.

All six of the common edible and medicinal plants were reduced in abundance in the first growing season following wildfire, but all were present as they all resprouted. For all six species, prior treatment did not alter their response to wildfire (Figure 9 and 10). In particular:

Huckleberry and serviceberry. There was no significant difference between T and TB plots, nor between TB and B plots (Figure 9 and 10). With both species, variability is higher within the TB plots than within the T and B plots.

Strawberry. There was greater abundance within the TB plots than within the T plots (Figure 9). There was no significant difference between TB and B plots.

Dwarf rose. There was no significant difference in cover of dwarf rose between T and TB plots, nor between TB and B plots for dwarf rose (Figure 9). However, cover was more variable within untreated plots (B plots) following wildfire without prior treatment (Figure 9).

Kinnikinnick. There was lower abundance of kinnikinnick within the TB plots than within the T plots (Figure 10). There was no significant difference between TB and B plots for kinnikinnick. Cover was less variable within all pairs following the wildfire.

Heartleaf arnica. There was higher abundance of heartleaf arnica within the TB plots than within the T plots. There was no significant difference between TB and B plots. Cover was more variable within all pairs following the wildfire.

Integrating Cultural Values into Fuels Reduction Treatments

Interpretation of Cohen's kappa. For the two reviewers, we received a Cohen's kappa statistic of .64 and .73, which is interpreted as substantial agreement. According to Viera and Garret (2005) and Cohen *et al*. (2013), substantial agreement falls between .61 and .80.

It is important to note that not all participants commented on all of the questions regarding treatment type and also, some participants made more than one comment that addressed one question. It was determined that a PGIS participant made more than one comment when they addressed more than one theme in the same answer. Regarding the effects of fuels treatments on the gathering of cultural plants and materials, there was a total of 67 comments. There were 30 comments from 31 PGIS participants regarding the impacts of mechanical thinning on cultural plants. There were 21 comments from 19 PGIS participants regarding the impacts of prescribed burning on cultural plants. There were 16 comments from 18 PGIS participants regarding the impact of wildfire management on cultural plants.

Out of all of the comments we received regarding effects of fuel treatments on cultural plants, there were nearly equal number of comments regarding mechanical thinning as beneficial as there were regarding it as damaging to cultural plants (Figure 11). The comments regarding prescribed fire and wildfire were very similar, with the majority of comments viewing both wildland and prescribed fire as beneficial, the rest of the comments showing that certain precautions or techniques needed to be used before the commenter could view the treatment type as beneficial.

The majority of comments made were in favor of more fuel treatments (Figure 12), as described below. The percentages reported here reflect the proportion of all comments regarding the treatment category:

Mechanical thinning. Regarding cultural plants and practices, specific recommendation themes included: do more treatments (39%); no recommendation (23%); remove slash in a more timely manner (6%); combine mechanical thinning with fire (6%); make fewer roads (9%); select trees to remove based on ecological concerns rather than economic value (3%); and natural fire is best (3%).

Prescribed Fire. Regarding cultural plants and practices, specific recommendation themes included: need more treatments (64%); and allow more wildfires to burn (11%); no recommendation (10%); mimic natural variability (7%); need less treatments (4%); benefit depends on timing (4%).

Wildfire. Regarding cultural plants and practices, specific recommendation themes included: allow wildfire to burn when safe (75%); need more fuel treatments for wildfire to be successful (8%); avoid post-fire removal of timber and debris (8%); and leave burned areas alone (8%).

The maps produced from the PGIS mapping exercise show where respondents felt fuels treatments would be most beneficial for cultural plants (Figure 13) and where they should not be applied (Figure 14) based on all responses. The maps represent all responses from PGIS participants, with red being the greatest level of concern and yellow being of less concern. Areas on or close to the CCT border are high priority for fuel treatments for respondents. This is the area where treatments are currently being planned. Areas where participants felt that fuels reduction treatments should be avoided were congregated around the Canadian/Washington border, around mountain tops, watersheds, prayer sites, and other sensitive locations that participants felt could be damaged more by fire suppression tactics or fuel treatments than by wildfire alone.

DISCUSSION

The heat maps produced from PGIS responses showed that our vegetation plots were located within areas where a majority of participants wanted to see more fuels treatments accomplished, which is likely due to proximity of the plots to the Colville Reservation and in response to the recent North Star Fire that burned less than two months prior to when we conducted our PGIS exercise.

All fuels reduction treatments were perceived as having an impact on cultural plants and materials, whether damaging, beneficial, or a little bit of both, depending on various factors. Fuels reduction treatments, such as understory thinning, can significantly reduce fuel loadings and can increase forest resilience to large wildfire events and enhance forest recovery (Hudak *et al.* 2011, Stevens-Rumann *et al.* 2013). Some PGIS participants felt that timely removal of slash from mechanical treatments is crucial for preventing harm to culturally significant plants, as well as for improving access to foods, medicines, and firewood. Our fuel loading results supported this PGIS finding, as 1-, 10-, and 100-hour timelag fuels were significantly reduced in the treated and un-treated plots burned by the North Star Fire. A reduction in 1-hour and 10-hour timelag fuels would likely reduce intensity and rate of spread when fires ignite.

Almost as many participants that perceived mechanical treatments as detrimental as those that perceived them as beneficial for cultural plants and practices. However, there was a dominant perception of both prescribed fire and wildfire being beneficial for cultural plants and practices. A majority of the PGIS comments were in favor of using wildland fire for resource benefit and prescribed fire over mechanical thinning alone. Some participants explained that there were some traditional plants, such as huckleberry and cedar, that are favored by fire but not by mechanical thinning. This cultural value of fire was supported by our finding that all burned plots (TB and B), whether treated or not, showed significantly higher understory plant species diversity than in the treated plots that were not burned by wildfire at all (T). Also, we found increased species richness within treated and burned (TB) plots, which is consistent with the PGIS comments that stated the importance of combining fuels treatments with fire to reduce the potential negative impacts of wildfire.

PGIS comments regarding the value of natural variability of wildfire over prescribed fire and mechanical thinning are also supported by our results. Consistent with CCT tribal members' comments in the PGIS exercise, burn severity has been linked to understory plant species richness (Lentile *et al*. 2007) and mixed-severity fires tend to increase the diversity of landscapes by offering islands of burned and unburned terrain for species with varying levels of fire-adaptations (Griffis *et al*. 2001; Schwilk *et al*. 2009; Burkle *et al*. 2015).

Most of the PGIS participants were in favor of a combination of mechanical thinning and prescribed fire compared to mechanical thinning alone. Although there was an overall agreement amongst PGIS participants on the benefits of mixed and low-severity wildfire, many voiced their concerns regarding the risk of a stand-replacing fire, such as what was seen within the interior of the 2015 North Star fire on the Okanogan Wenatchee National Forest and Colville Reservation. Commercial tree removal post-wildfire, as well as use of logging equipment during and post-wildfire were of concern due to the increased risk such equipment brings for introducing invasive plant species and damage to existing cultural plants. Similarly, Morgan *et al.* (2015) found that have shown that post-wildfire activities such as salvage logging in areas burned with high-severity can reduce understory plant species richness, diversity, and cover. Likewise, in the Mediterranean, Leverkus *et al.* (2014) found that total plant cover and percent cover of understory plant species was lower in locations that were burned by wildfire and salvage logged than in the locations that were burned with no post-fire logging.

Our results on plant diversity support both current science and the traditional knowledge, which suggest that, if the maintenance of species diversity within our ecosystems is a desired outcome, local managers need to strategically follow up mechanical thinning projects with some form of treatment, such as prescribed burning, particularly if treatments break up the homogeneity of the landscape (Schwilk *et al.* 2009, Navalho *et al*. 2017, Keane *et al*. 2002, Baker 1992), though Hessburg *et al.* (2015) emphasize that heterogeneity should be informed by historical heterogeneity. The most cost-effective ways to achieve this is to plan and implement prescribed burns with the goal of mimicking the natural variability of wildfire as closely as possible to find opportunities for managing wildfires to play a natural role on the landscape when conditions are safe and practical (Houtman *et al*. 2013, Hessburg *et al.* 2015).

Traditional Knowledge and Cultural Plants Response to Wildfires

Tribal participants pointed out the important role that fire plays in of rejuvenating and increasing the quality of the culturally important plants over time. Since our plot data was collected during the first growing period after the North Star Fire, our data may be showing an initial post-fire decrease, which may or may not be followed by an increase in abundance during the following growing season (Leege 1985, Stucker 1984, Ahlgren 1974). With that in mind, plant response to wildfire within treated and untreated plots was consistent with many of the PGIS comments:

Huckleberry. Huckleberry tends to sprout from rhizomes following fire (Flinn and Wein 1977), which is consistent with the relatively high cover of huckleberry in the first growing season post fire. Although huckleberry canopy cover did not significantly differ in the TB and B plots, the berries appeared larger and the foliage more thick within TB plots (M. Wynecoop, personal observation). Some PGIS participants stated that the burning combined with opening up the canopy increased the size of the berries due to increased sunlight and nutrients within the berry patch, which was similarly reported by Gottesfeld (1994) and Boyd (1999). We would recommend that future plots include a measure of above-ground biomass of fruits and leaves, which will better reflect the influence of fire on berry production for huckleberry. Tribal PGIS participants indicated great concern for the impact that fuels reduction practices and wildfire might have on their huckleberry patches. Before and after pictures will also help communicate treatment and wildfire effects on all plants.

Serviceberry. Serviceberry is a highly valued species for wildlife browse and cover. Our monitoring results may be valuable when addressing Tribal comments regarding the impact that fire has on gathering of foods and medicinal plants as well as on wildlife and whether or not thinning, prescribed fire, and wildfire will have a significant impact on hunting. Serviceberry tends to be extremely resilient to fire and sprouts well following top-kill from fire (Stickney 1991). Without change in browsing pressure, annual twig production tends to be greater following fire (Arno *et. al.* 1986). Similarly, in British Columbia Gottesfeld (1994) found that the local tribes commonly collected berries from Saskatoon serviceberry, but did not manage the bushes with fire like they did with their important huckleberry bushes.

Strawberry. Strawberry tends to have higher survival rates during fires when the meristematic tissue is protected by a moist duff layer when forests burn (Powell 1994), which could explain why we observed highly variable cover of strawberry plants among and within TB and B plots. Though strawberry has been shown to increase following fire, there have been studies that have shown short-term post-fire decrease in abundance of strawberry and moderate rate of regrowth following fire, where it can take up to 5-10 years to regain pre-burn abundance (Munger 2006).

Kinnikinnick. How well kinnikinnick (also known as bearberry) is established prior to the fire burning and how severely the fire burns both influence post-fire abundance of kinnikinick (Fischer *et. al*. 1987). The percent cover of Kinnikinick may decrease greatly where it is rooted in organic matter that is consumed in the fire. It is less likely to be harmed by wildfires when it is rooted in mineral soil (Crane 1991). Due to its moderate growth rate (Crane 1991), kinnikinnick seems to benefit from being within areas that undergo moderate- to low-severity fire with fire return intervals long enough to allow root establishment deep within mineral soil. Kinnikinnick is also a culturally important species, both for medicine (Hart 1976) and as important winter cover and browse for wildlife (Hill 1946, Hatler 1972, Keown 1997). It is especially important spring browse for bears when they come out of hibernation (Keown 1997, Hatler 1972). Spring prescribed burning while some moisture remains in the soil could benefit the plants and wildlife, allowing the plants and wildlife time to recover before the next winter and stimulating spring plant growth.

Heartleaf arnica. Heartleaf arnica has many medicinal uses for the Interior Salish groups of Washington and British Columbia (Turner 1988). It has been shown to have rapid regrowth through rapid flowing and heavy seed dispersal following fire (Keown 1978) and populations have also been shown to decline within a couple years post-fire (Geier-Hayes 1989) suggesting that frequent, low-moderate severity fire is beneficial to this species.

Dwarf rose. Dwarf rose is culturally important to humans and wildlife, both medicinally and nutritionally as a source of vitamins, fiber, fat, and protein during the winter (Welch and Andrus 1977, Turner 1988). Dwarf rose has been shown to respond well to low to medium severity fire and disturbance and will repopulate through rhizomes when top-killed by fire, as long as there is minimal damage to the root crown (Hooker and Tisdale 1974).

LIMITATIONS

We sampled vegetation response within only 30 plots, all in areas that burned with low severity in September 2015, and on only one fire. Our ten pre-wildfire plots were sampled in September, 2015, during the end of the growing season, which could have an impact on plant abundance data. However, the six plants that we focused on are all perennial species and were therefore easy to identify despite data collection occurring during the end of the growing season. Our post-fire plots were only sampled in the first growing season post-fire, in May 2016.

Our paired plot design was useful in detecting differences despite our small sample size, though less so for the five plot pairs comparing burned only to plots burned and treated, than for the ten pairs comparing treated and burned to treated only. More samples in more environmental conditions and more fires and over more years post fire will help determine if our findings apply more broadly. This is the purpose of ongoing CFLRP monitoring of fuels treatment and fire impacts on tribal and non- tribal community values. The Colville Tribe Natural Resource Committee has expressed high interest in seeing, not only how treatments are impacting social values, but also how all of the plots have responded to wildfire, even if they aren't in highly sensitive cultural use areas.

An additional study that solicits feedback from a larger group of CCT participants could be more representative of the CCT. We primarily involved CCT elders and professionals that worked in natural resource management. While this might have increased the amount of detail provided in responses from a small number of participants, it may not be broadly representative of tribal members.

Technological difficulties hampered our efforts. Developing trust with tribal members, especially elders, is difficult and takes time. We sought to be transparent and trustworthy. We sought to ensure that the participants, especially elders, know that we were working on their time frame and were willing to assist them in any way possible to feel comfortable and respected. We will make further changes in the PGIS program so that everyone, especially elders, are able to spend as much time as needed without the session "timing" out on them.

CONCLUSIONS

This CCT consultation sets a good example for what can be done with the combination of TK and Western Science. With approval from the Confederated Colville Tribes, we may be able to move forward with a larger study that involves a more representative sample of people, more participants, and can be repeated to determine whether or not this exercise is improving Federal management of the North Half for CCT values. Further, we could repeat our PGIS exercise through time to help determine if trust is increasing with consultation.

For ancestral lands, sustainability involves hearing from the tribal communities that are intimately connected to the local landscape. Recently, Lake *et al*. (2017) summarized the key points from two workshops that were held in 2012 and 2015 to help determine how traditional knowledge and western science can be used to improve fire and fuels management and research. The main "take-away" point was that, "successful management of wildland fire and fuels requires collaborative partnerships that share traditional and western fire knowledge through culturally sensitive consultation, coordination, and communication for building trust" (Lake *et al*. 2017). Here, we have addressed that communication and cultural gap in management and science. We address the need for managers and scientists to take a multi-disciplinary and more holistic approach (Grimble and Wellard 1997, Berkes and Folke 1998) to understand and manage the cumulative effects of wildfire and common fuels reduction treatments on understory plants of importance to tribal communities for the perpetuation of socio-ecological systems.

Despite the need, few studies combine Western Science and Traditional Knowledge of local and indigenous communities, which is necessary for a comprehensive response to environmental and management impacts on traditional life-ways (Nat. EPA 2011). Globally and nationally, applications of this approach can strengthen communities and build relationships between agencies and communities (Bowman *et al.* 2009, Lynn *et al.* 2013, McWethy *et al*. 2013). Focusing on food, medicine, and cultural-based values of our precious natural resources will serve to strengthen and return the human connections to our socio-ecological landscapes. We hope that this project with its multi-disciplinary approach will show the benefits of bringing back the tradition of suméš and honor that fire managers have traditionally held by returning the community feedback loop and Traditional Knowledge to our everyday practice.

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TABLES

Table 1. Cultural plants chosen for abundance analysis based on edible and/or medicinal properties and relevancy to PGIS comments. Names are from USDA Plants Database.

Common Name	**Scientific Name**
Serviceberry	*Amelanchier alnifolia*
Huckleberry	*Vaccinium spp.*
Heartleaf arnica	*Arnica cordifolia*
Wild rose	*Rosa gymnocarpa*
Kinnikinnick	*Arctostaphylos uva-ursi*,
Wild strawberry	*Fragaria spp.*

Table 2. Common themes for management addressed by PGIS participants (n=37) were organized into perceived impacts on gathering of cultural plants & materials, management recommendations, and desired outcome of mechanical thinning, prescribed fire, and wildfire. NA= those comments that included a perceived impact and desired outcome but not a management suggestion. Depends= the impact depends on whether or not the desired outcome is met.

MECHANICAL THINNING		
Perceived Impact	**Management Suggestion**	**Desired Outcome**
Beneficial	More Treatments	Native Plants Benefit
Beneficial	NA	Reduce Stand Replacing Fire
Beneficial	NA	Reduce Smoke
Beneficial	More Treatments	Huckleberry Plants Become Healthier

Beneficial	More Treatments	Access Improves for Public & Tribal Members
Beneficial	More Treatments	Access Improves for Public & Tribal Members
Beneficial	More Treatments	Cedar Roots Straighter & Better Quality for Basketry
Beneficial	More Treatments	Huckleberry Berries Grow Larger
Beneficial	More Treatments	Thin Understory Vegetation
Beneficial	More Treatments	Access Improves for Public & Tribal Members
Beneficial	NA	Access Improves for Public & Tribal Members
Beneficial	More Treatments	Native Plants Benefit
Beneficial	More Treatments	Thinned Understory Vegetation More Productive
Beneficial	More Treatments	Thinned Understory Vegetation More Productive
Beneficial	More Treatments	Native Plants Benefit
Damaging	NA	Assess Short Term Damage from Operations
Damaging	Less Roads	Huckleberries not overpicked or overbrowsed
Damaging	Less Roads/Log Decking	Avoid Damaging Medicinal Foods
Damaging	Less Roads	Reduce Heavy Metals in Edible & Medicinal Plants
Damaging	Less Treatments	Understory Vegetation Grows Bigger & Better
Damaging	Less Treatments	Damaged Native Plants Need Shade and Water to Recover
Damaging	Less Treatments	Avoid Damage to Native Plants so they Return
Damaging	Natural Fire is Best	Forest Ecology & Cultural Plants benefit most from natural fire
Damaging	Reduce Commercial Tree Selection	Prioritize tree take based on forest need, not money
Depends	NA	Management Practice Depends on Species Focus
Depends	NA	Management Practice Depends on Species Focus
Depends	NA	Short Term Damage for Long Term Benefits
Depends	Combine with Fire	Fire-Adapted Traditional Plants benefit
Depends	Combine with Fire	Stimulate Traditional Plant Growth
Depends	Remove Slash	Avoid excessive ignitions due to slash accumulation

Depends	Remove Slash	Improve Access to food, medicines, and firewood

PRESCRIBED BURNING

Perceived Impact	Management Suggestion	Desired Outcome
Beneficial	More Treatments	Improve Access for elders
Beneficial	More Treatments	Fire-adapted Traditional Plants flourish
Beneficial	More Treatments	Improves Wildlife Corridors
Beneficial	More Treatments	Improves Cultural Plants
Beneficial	More Treatments	Healthier Medicinal Plant Communities
Beneficial	More Treatments	Improve Access
Beneficial	More Treatments	Rejuvenates Plants & Nutrients in Plants
Beneficial	More Treatments	Reproduces New Growth & Increases Nutrients in Plants
Beneficial	More Treatments	Increase Mushroom Gathering Opportunities
Beneficial	More Treatments	Huckleberry Berries Grow Larger
Beneficial	More Treatments	Huckleberry Plants Become Healthier
Beneficial	More Treatments	Fire Adapted Plants Benefit
Beneficial	More Treatments	Fire Adapted Plants Benefit
Beneficial	More Treatments	Allows Native Plants to Regenerate & Eliminate Competition
Beneficial	More Treatments	Burned Understory Vegetation Healthier & More Productive
Beneficial	More Treatments	Improves Overall Forest Health
Beneficial	More Treatments	Reduce Stand Replacing Fire
Beneficial	More Treatments	Healthier Medicinal Plant Communities and Ecosystem
Damaging	Less Treatments	Prevent Disturbing the Cultural Plants too much
Depends	NA	Work with Tribe to Protect Sensitive Cultural Spots
Depends	Mimic Natural Variability	Produce Natural Patchiness

Depends	Depends on Timing	Time Around When Most Beneficial to Cultural Plants
Depends	NA	Improves Availability of Cultural Plants and Reduces Invasive Plants
Depends	NA	Prevent Favoring Invasive Species
Depends	More Wildfire	Not a Viable Investment
Depends	Mimic Natural Variability	Plants Need Areas of Lower Intensity so They can Re-establish

WILDFIRE

Perceived Impact	**Management Suggestion**	**Desired Outcome**
Beneficial	Allow to Burn when Safe	Clears Excessive Overgrowth & Opens up Habitat for Cultural Plants
Beneficial	Allow to Burn when Safe	Makes Cultural Plants Stronger
Beneficial	Allow to Burn when Safe	Allows Cultural Plant Rebirth
Beneficial	Allow to Burn when Safe	Clears Weeds
Beneficial	Allow to Burn when Safe	Bigger Berries & Healthier Producing Trees
Beneficial	Allow to Burn when Safe	Makes Cultural Plants More Available
Beneficial	Allow to Burn when Safe	Improves Overall Forest Health
Beneficial	Allow to Burn when Safe	Helps Clear Soil of Weeds
Damaging	Need More Fuels Treatments	Keep Wildfires on the Ground & Out of the Canopy
Depends	Leave Burned Areas Alone	Area Recovers & Wildlife Return if Tractors & Logging Equipment Stays Out
Depends	Don't let Fire Burn too Hot	Prevent Damage to Cultural Plants
Depends	Avoid Post-fire Removal of Debri	Prevent Damage to Cultural Plants
Depends	Allow to Burn when Safe	Prevent Spread of Invasives from Suppression Tactics & Equipment

FIGURES

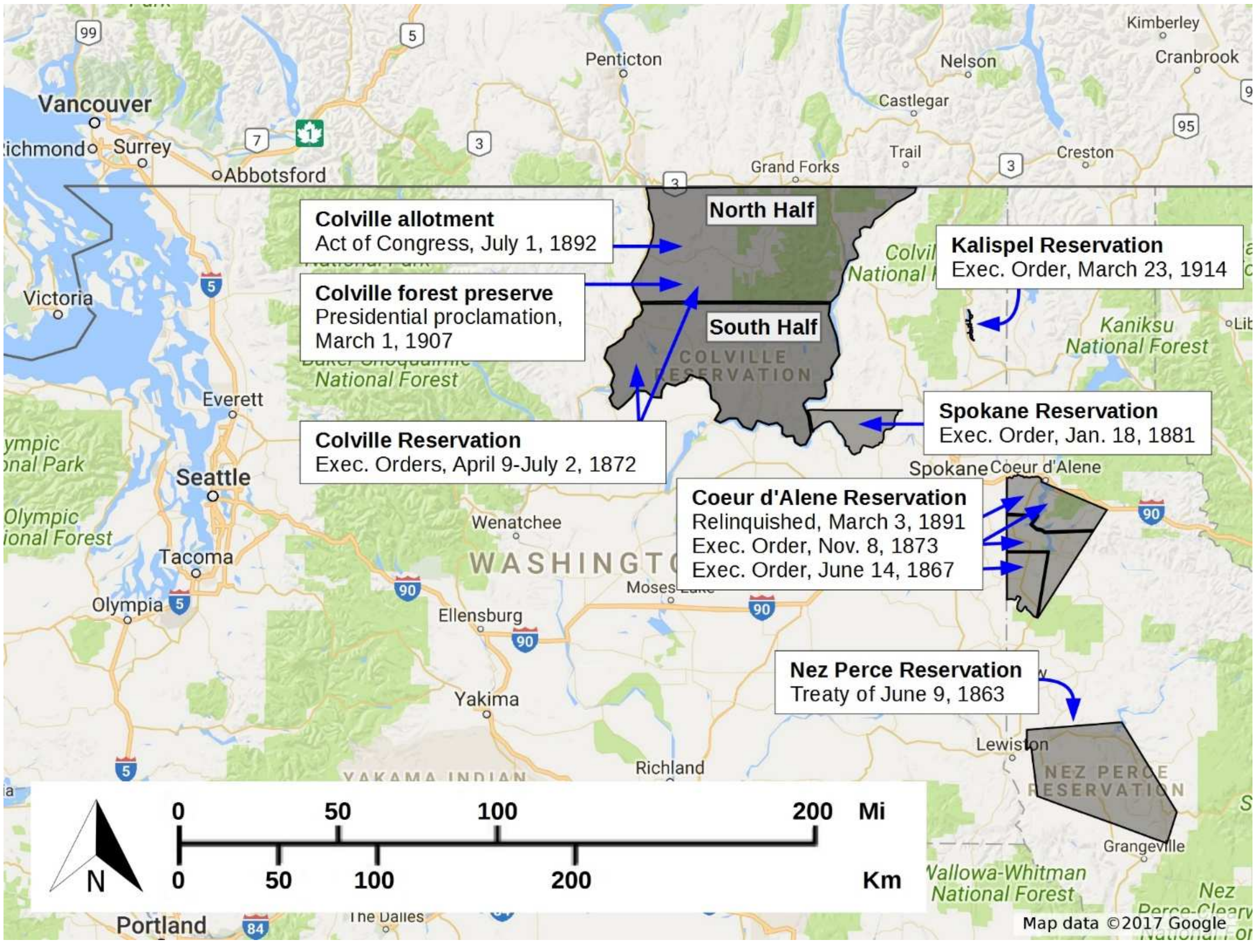


Figure 1. Historic Perspective of the North Half: The reservations to which the many bands that now comprise the Colville, Spokane, Kalispel, Coeur d’Alene, and Nez Perce Tribes were sent during the reservation period. Many of the original reservation boundaries, such as that of the CCT were decreased later on by an act of congress.

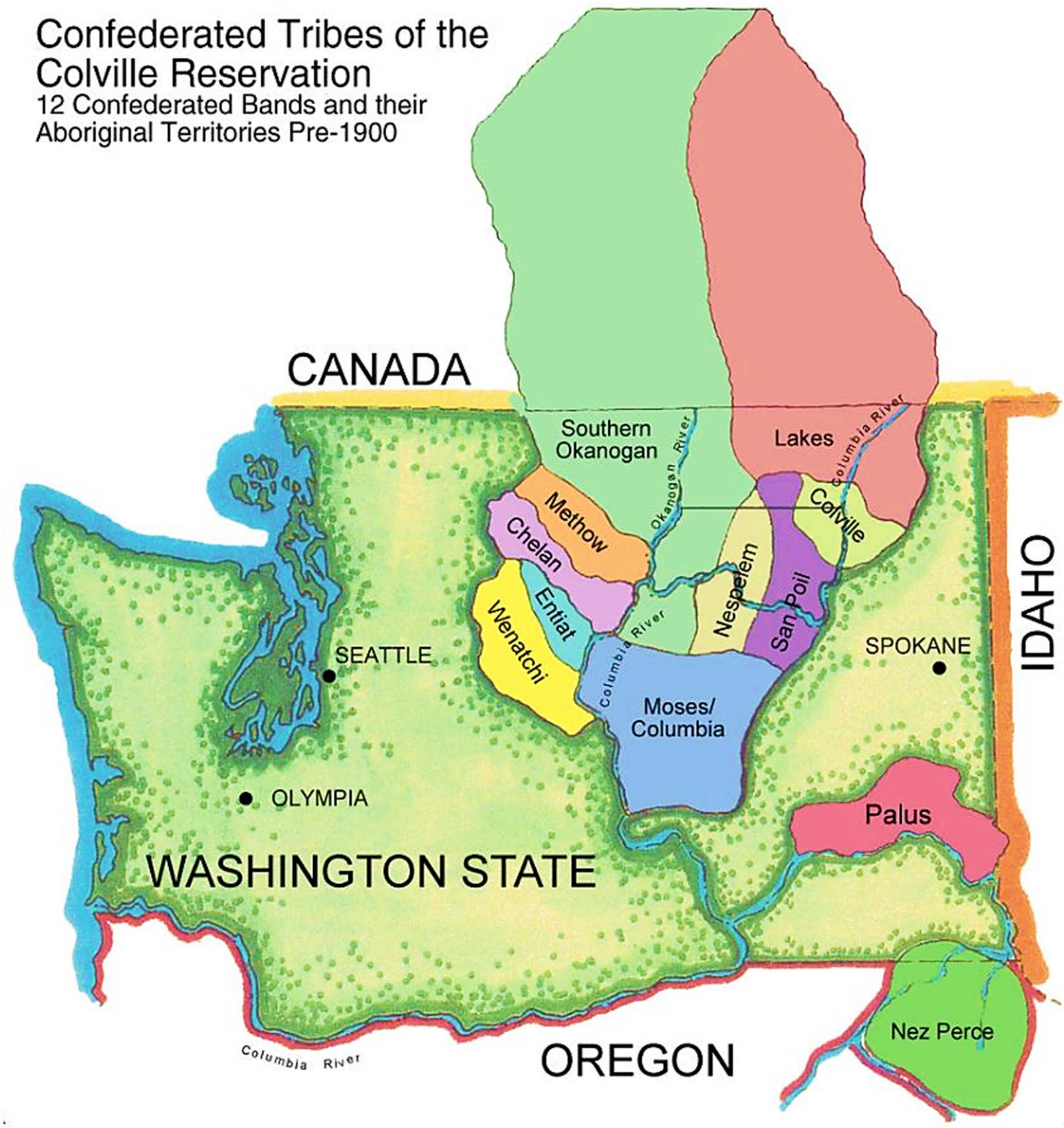


Figure 2. Ancestral Territories: The twelve confederated tribes that make up the CCT and their ancestral territories expanded far beyond what is now known as the CCT reservation boundary through Washington, Oregon, Idaho, and British Columbia (CCT 2017).

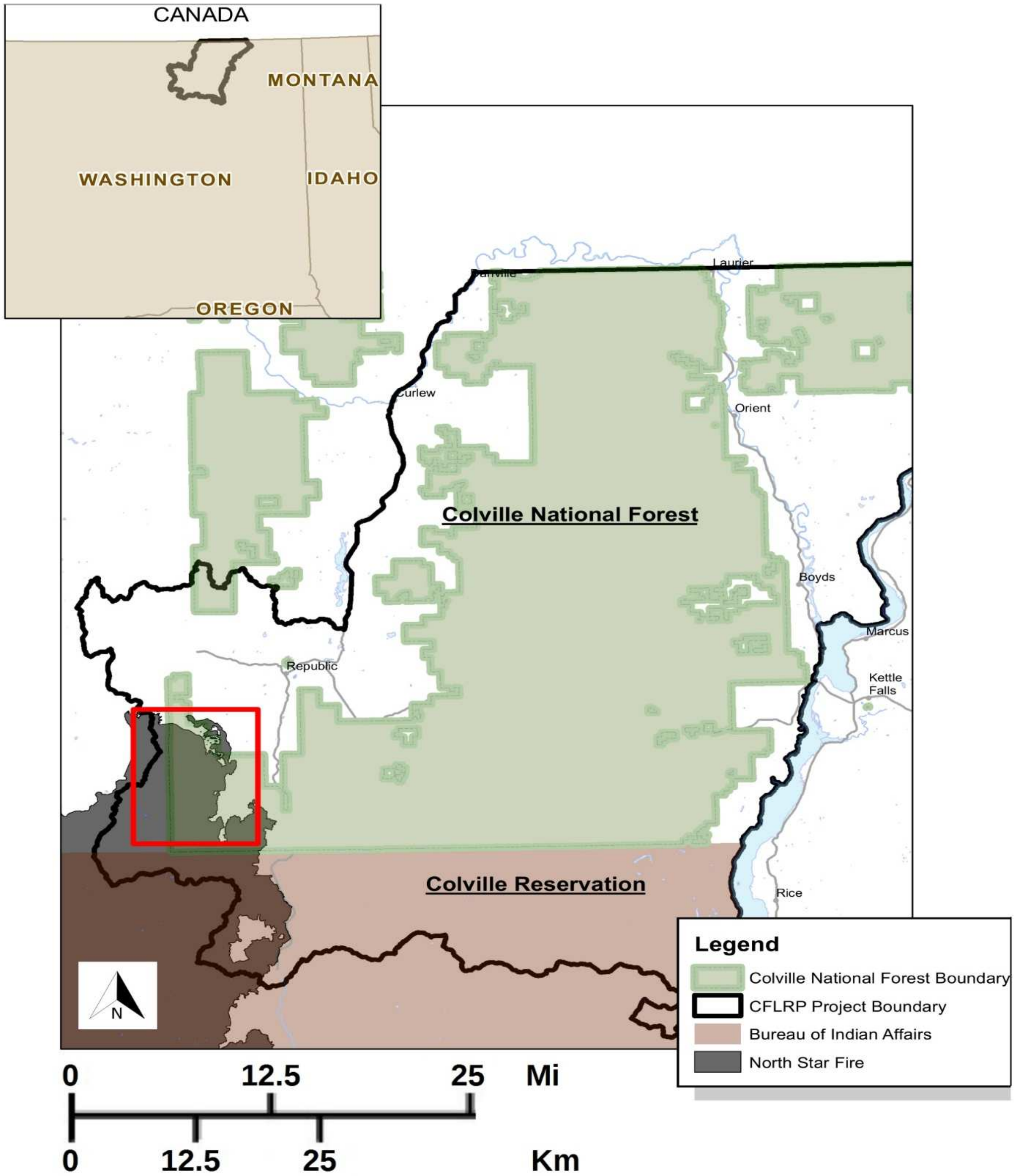


Figure 3. Project Study Area: Paired plots were sampled within the area outlined by the red box, the CFLRP project boundary (black) within the Colville National Forest (green) and the area burned by the 2015 North Star Fire (Grey) in northeastern Washington.

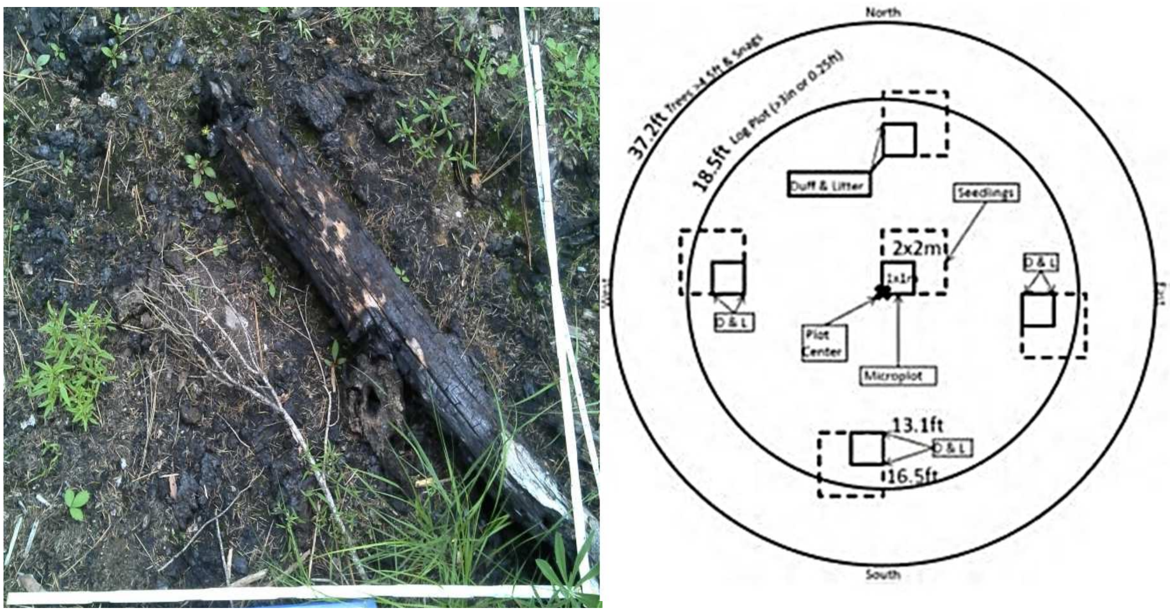


Figure 4. FireMon Plot Layout: Photo of a 1x1 meter plot (left) and the FIREMON plot layout (right) for sampling plant species richness, diversity, cover of individual plant species, and trees..For paired plots sampled pre- and post-fire, the exact location was sampled. Other paired plots were all sampled after the 2015 North Star Fire in similar locations that did and did not have prior fuels treatment.

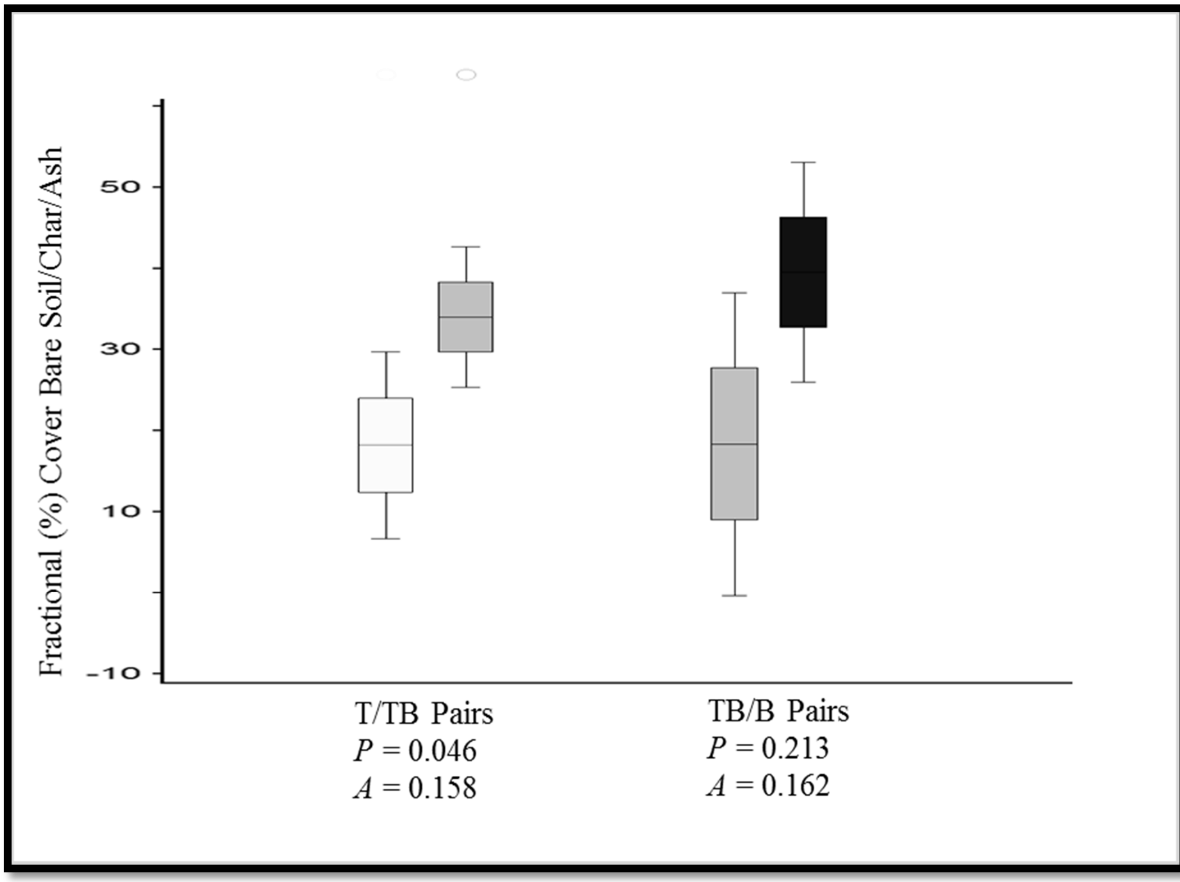


Figure 5. Fractional cover (%) of total bare soil, charred ground, and ash percent cover on paired plots. On the left, the white and gray box plots are for treated plots measured before (T) and after (TB) wildfire, respectively (ten plot pairs). On the right, the gray and black box plots are for treated and untreated plots burned by wildfire (TB/B), respectively (five plot pairs). The *P* and *A* values are from the MRBP analysis, and the error bars are the standard error (SE).

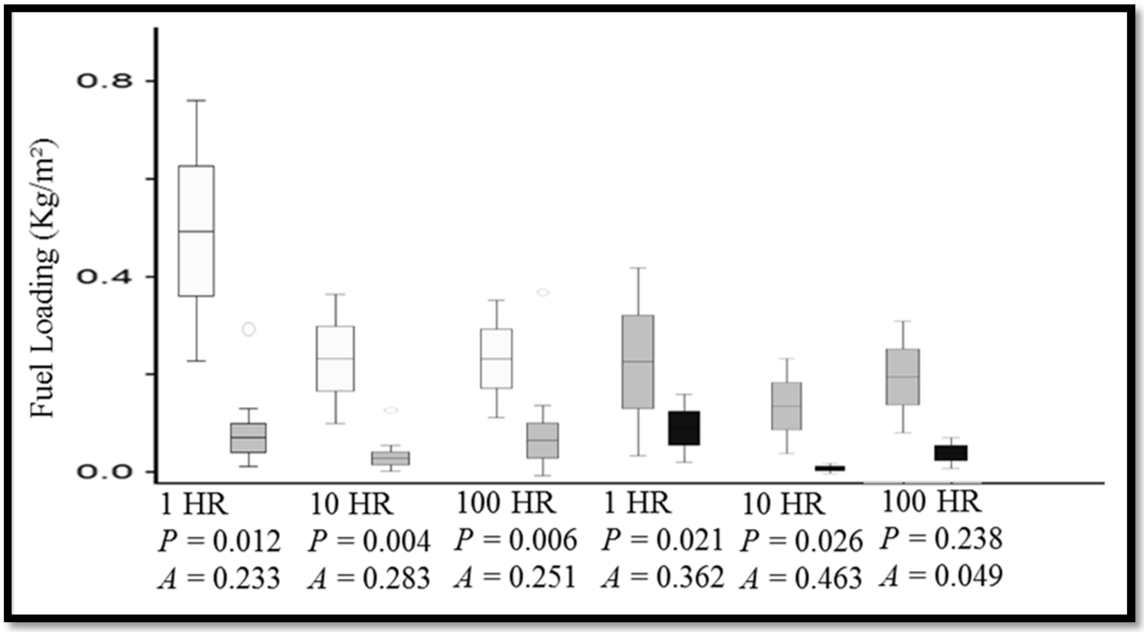


Figure 6. Surface fuel loading by size class of dead woody fuels. White box plots indicate T- treated sites not burned by wildfire with statistical analysis of differences for ten plot pairs (left). Grey box plots indicate TB- treated sites burned by wildfire; and the black box plots indicate B- untreated sites burned by wildfire with statistical analysis of differences for five plot pairs (right). The clear circles identify outliers and the T-bars are error bars. The *P* and *A* values are from the MRBP analysis.

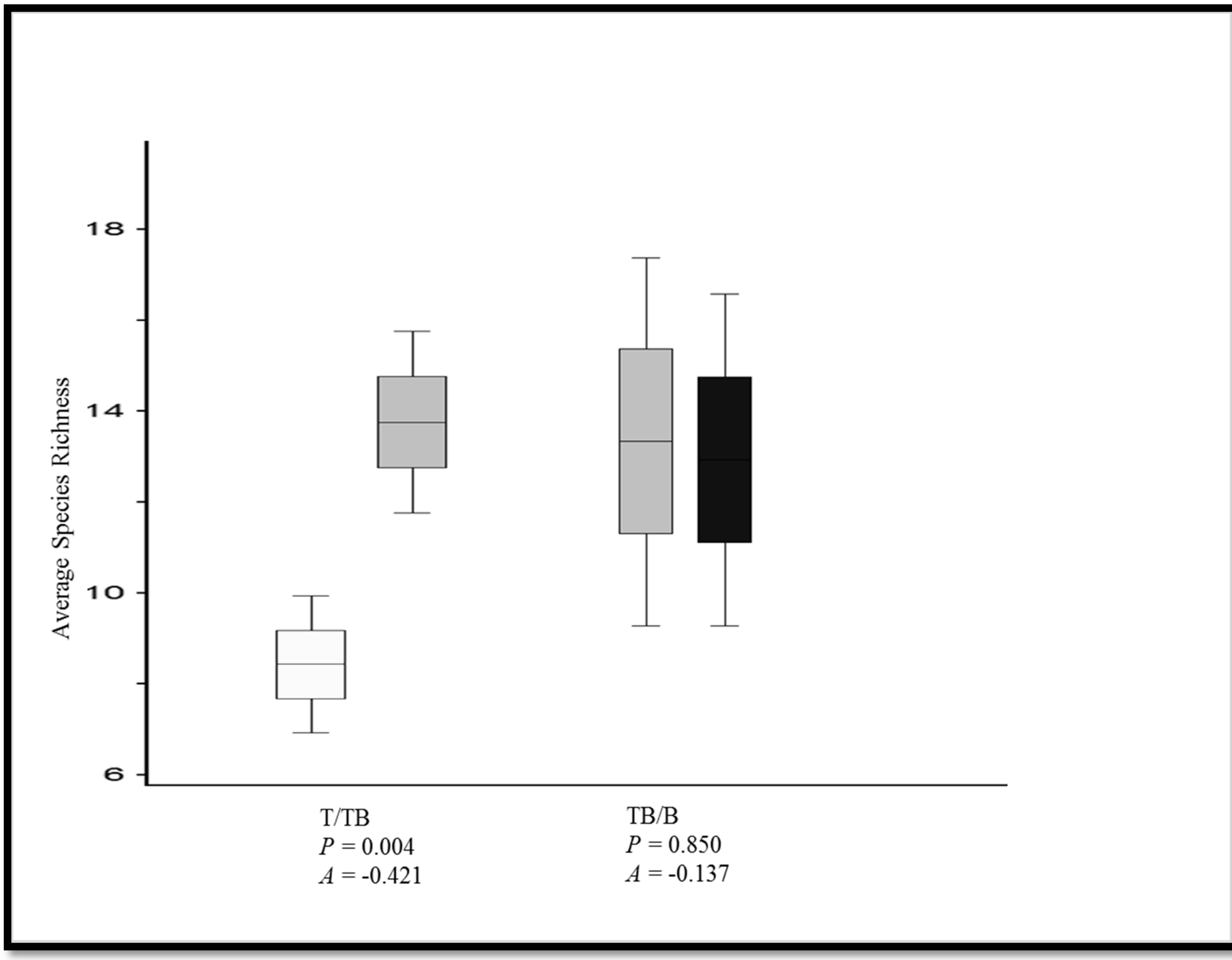


Figure 7. Paired analysis of species richness of understory plant species (N=58): White box plots indicate T-treated sites not burned by wildfire; grey box plots indicate TB- treated sites burned by wildfire; and the black box plots indicate B- untreated sites burned by wildfire. The *P* and *A* values are from the MRBP analysis. The T-bars indicate the Standard Error.

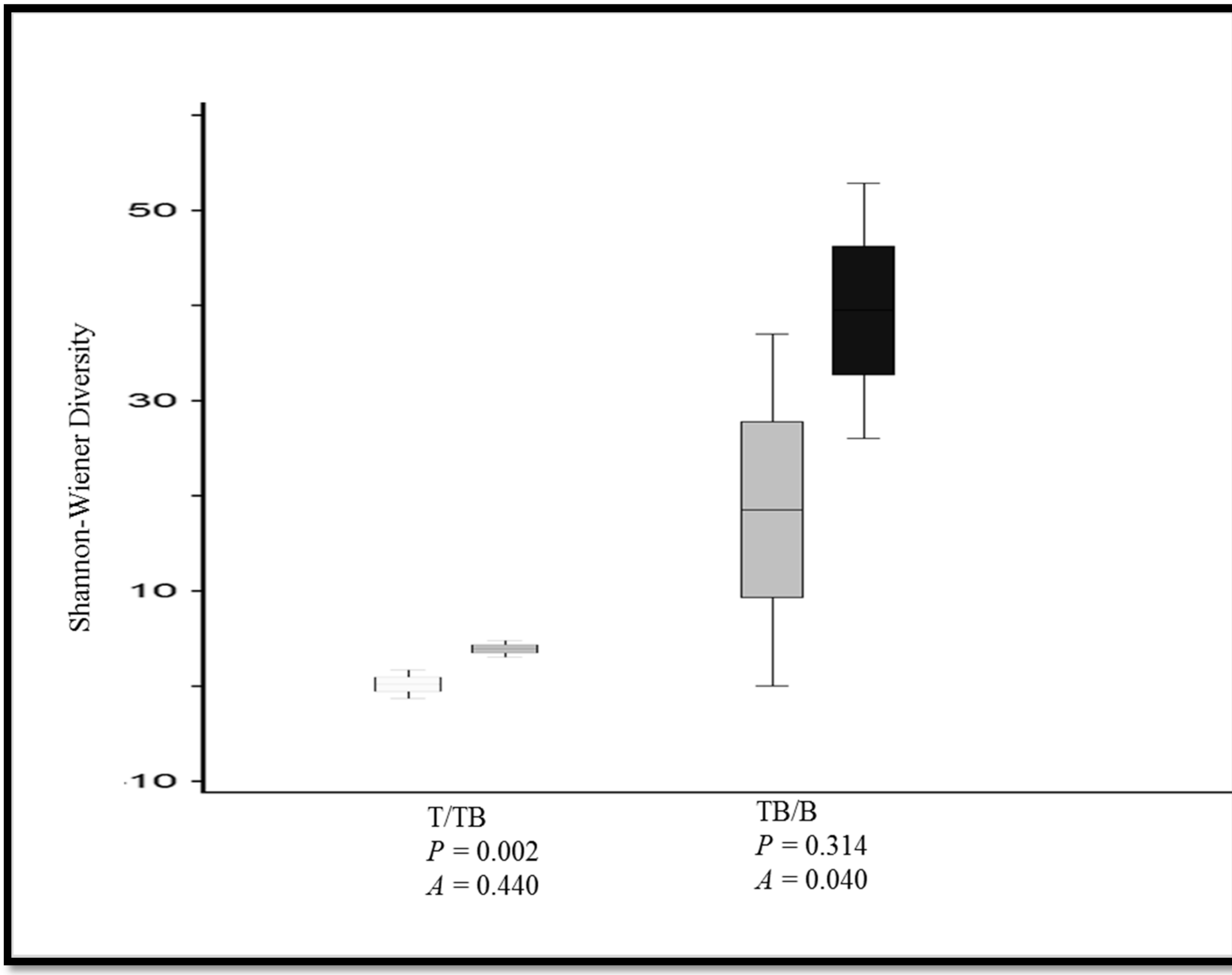


Figure 8. Paired analysis of Shannon-Wiener Diversity of understory plant species (N=58): White box plots indicate T-treated sites not burned by wildfire; grey box plots indicate TB-treated sites burned by wildfire; and the black box plots indicate B- untreated sites burned by wildfire. The *P* and *A* values are from the MRBP analysis. The T-bars indicate the Standard Error.

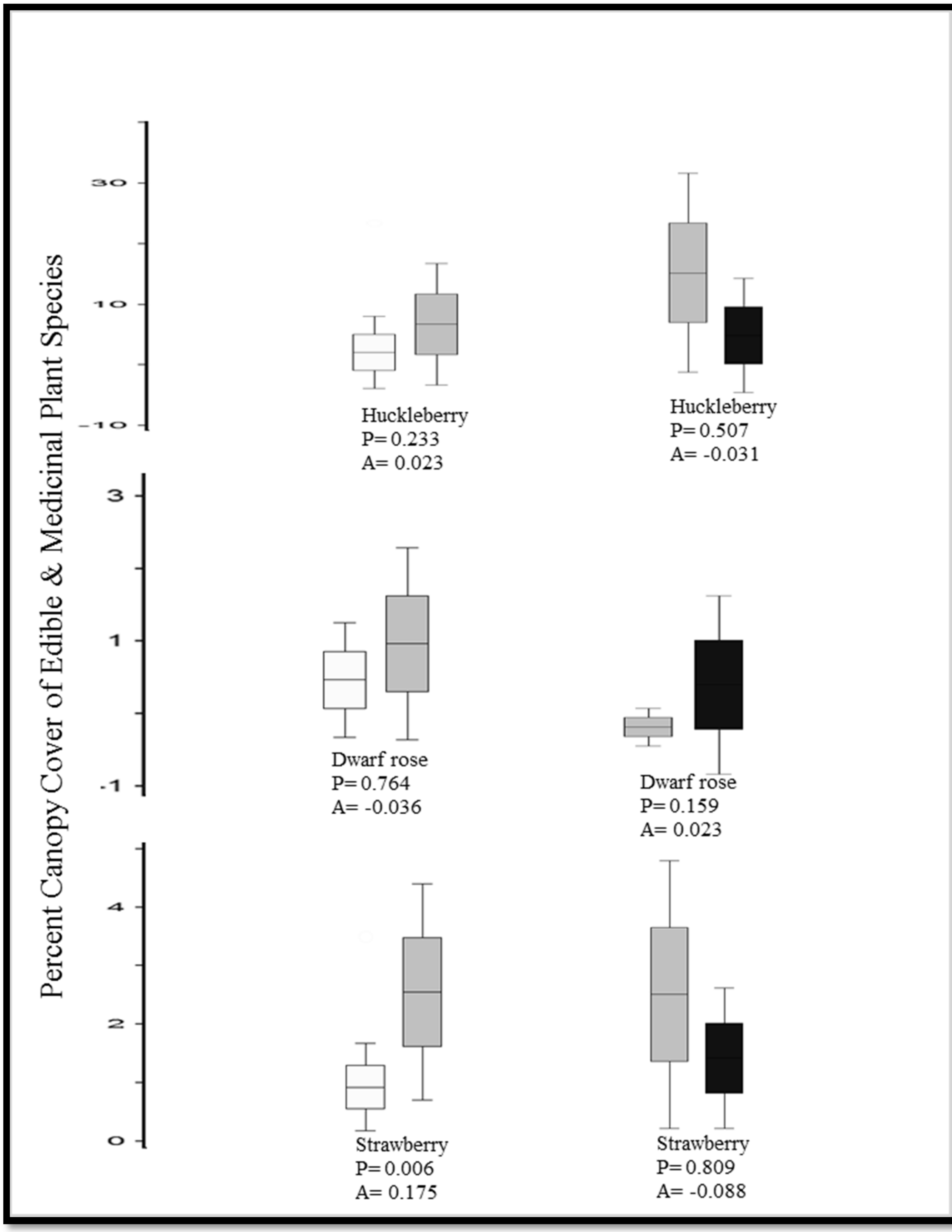


Figure 9. Cover (%) of edible and medicinal plant species. White box plots indicate T- treated sites not burned by wildfire; grey box plots indicate TB- treated sites burned by wildfire; and the black box plots indicate B- untreated sites burned by wildfire. The *P* and *A* values are from the MRBP analysis. The T-bars indicate the Standard Error.

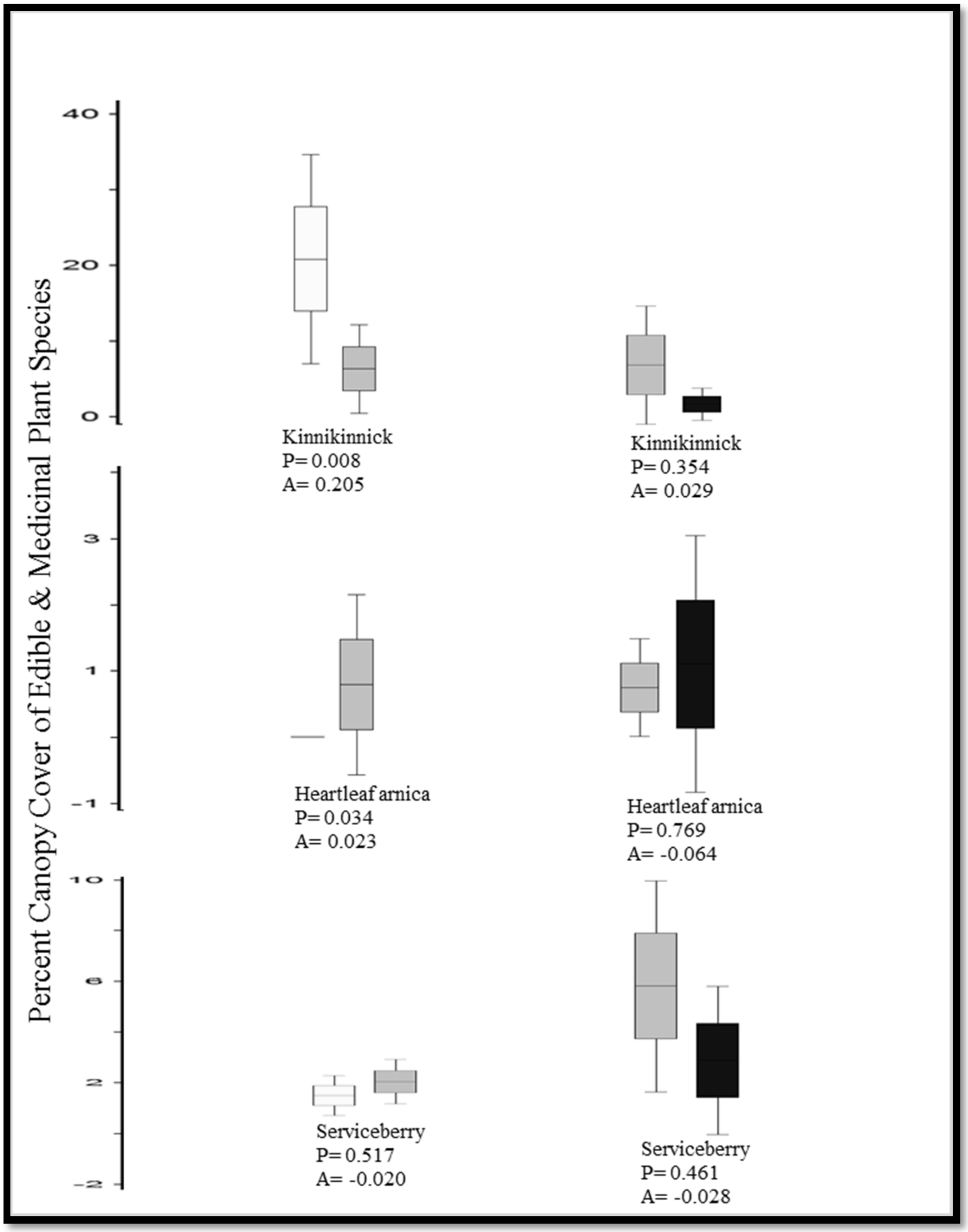


Figure 10. Cover (%) of edible and medicinal plant species. White box plots indicate T-treated sites not burned by wildfire; grey box plots indicate TB- treated sites burned by wildfire; and the black box plots indicate B- untreated sites burned by wildfire. The *P* = and *A* = values are from the MRBP analysis. The T-bars indicate the Standard Error.

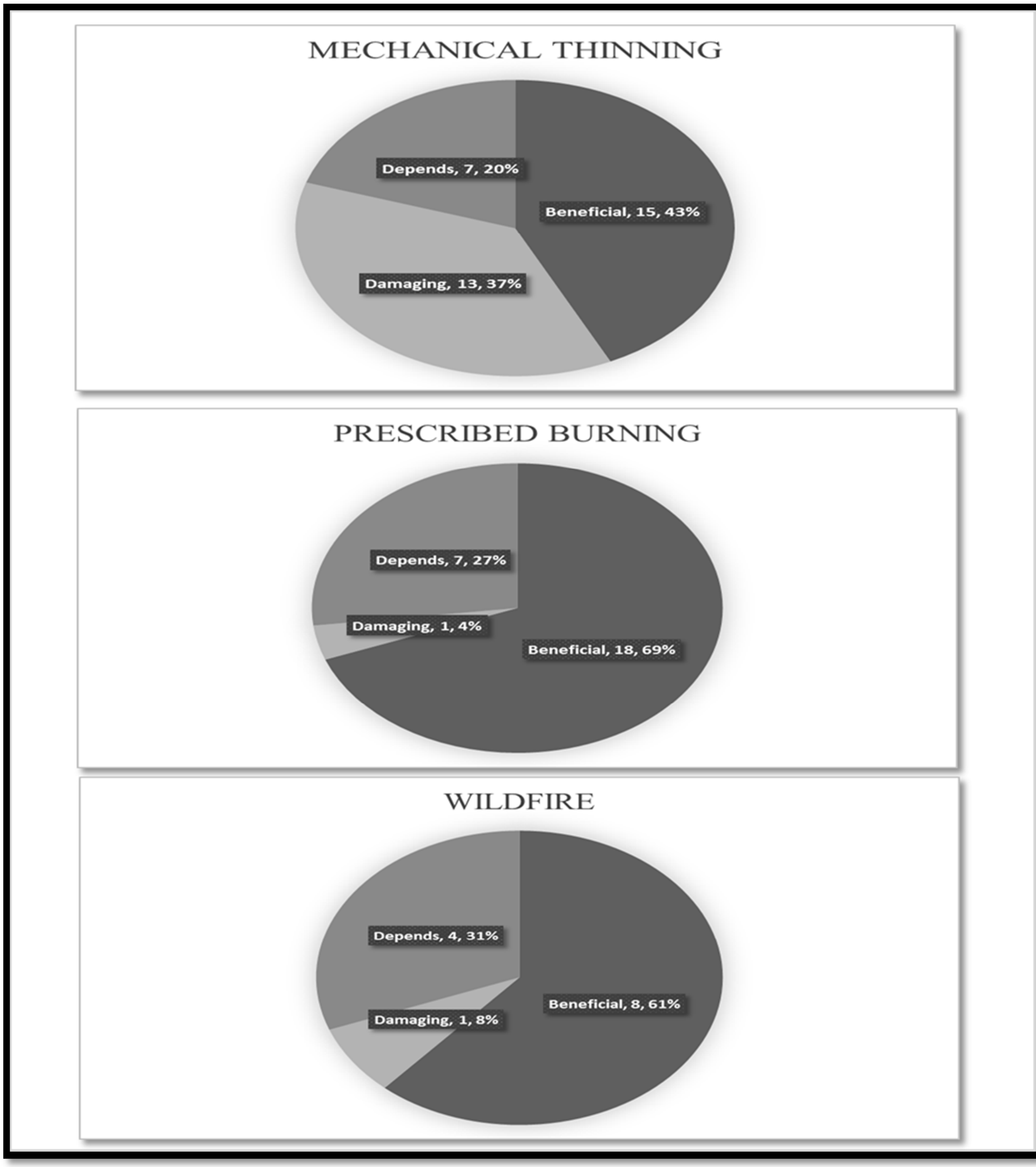


Figure 11. CCT Perceived impact of treatments on gathering of cultural plants: For each treatment category, a pie chart was made with perceived impact of that treatment (Beneficial, Damaging, or Depends). The percentage is the how many times each suggestion was mentioned out of total comments made for that treatment category.

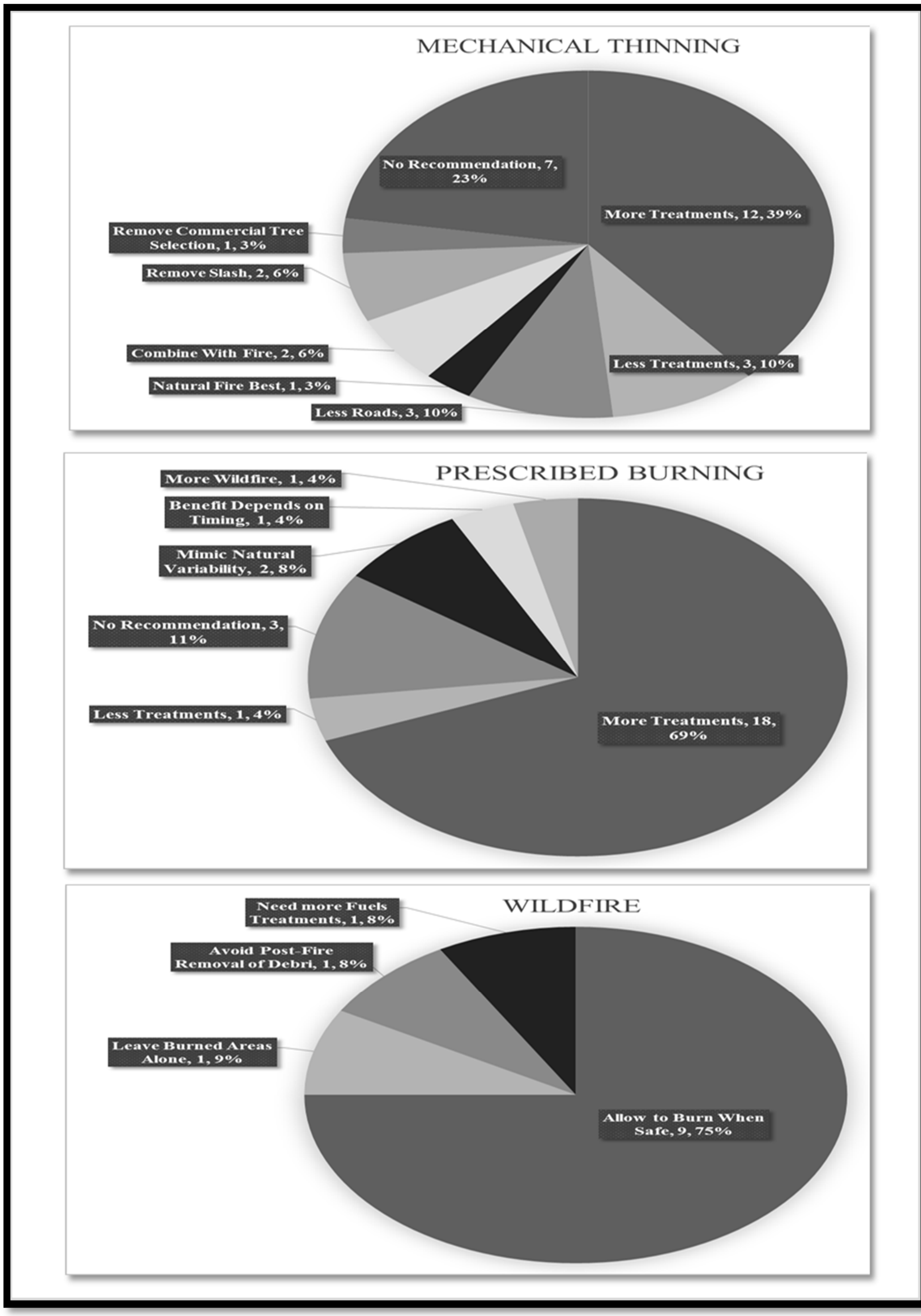


Figure 12. CCT Management Suggestions for Benefitting Gathering of Cultural Plants: For each treatment category, a pie chart was made with management suggestions and the percentage is the how many times each suggestion was mentioned out of total comments made for that treatment category.

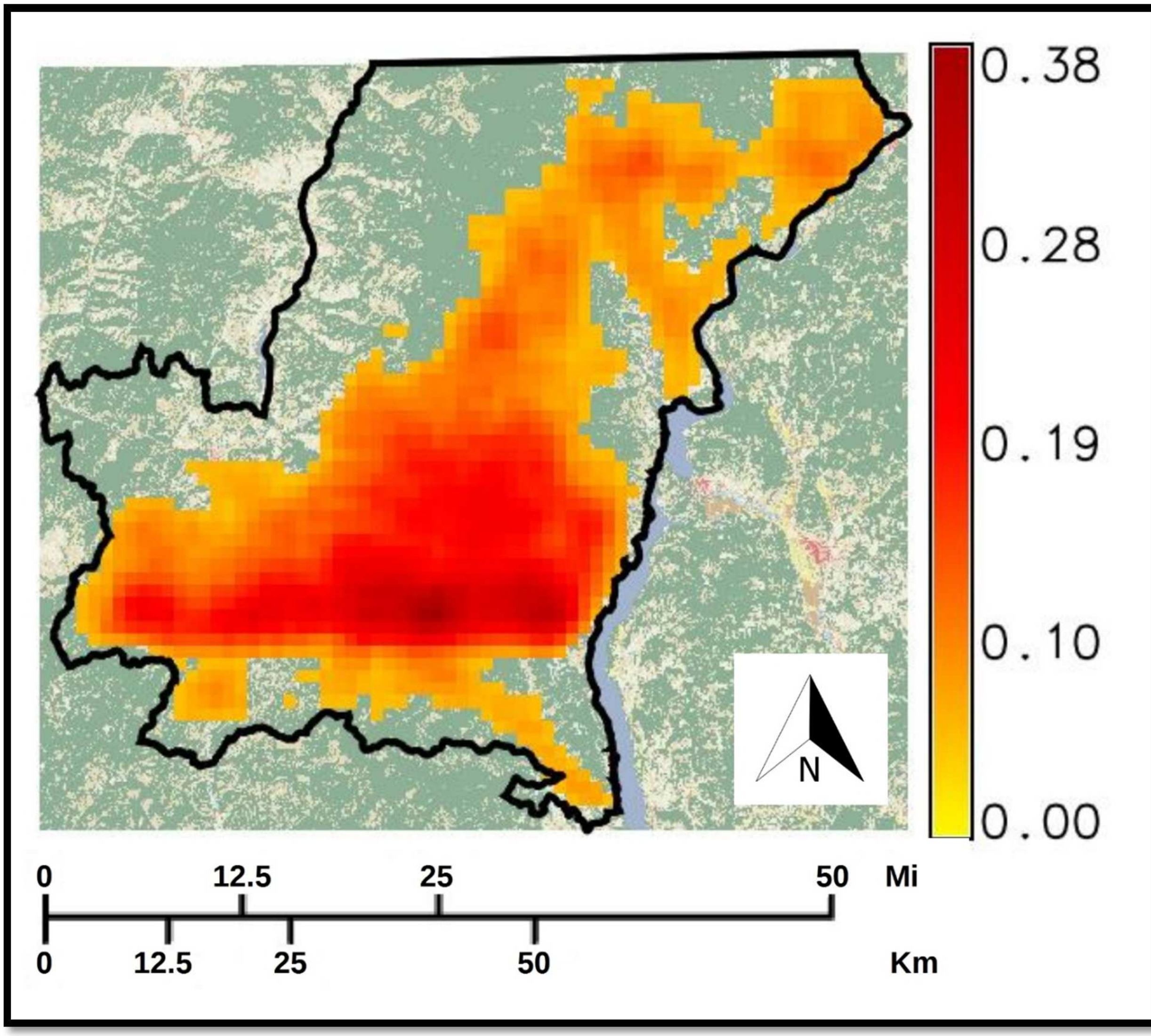


Figure 13. Areas where PGIS participants (n=37) felt that fuels treatments could be applied on the Colville National Forest. The value to the right of the map represents the percent of people (rescaled to a 0-1 scale) that identified a particular location of the study area as benefitting from treatments.

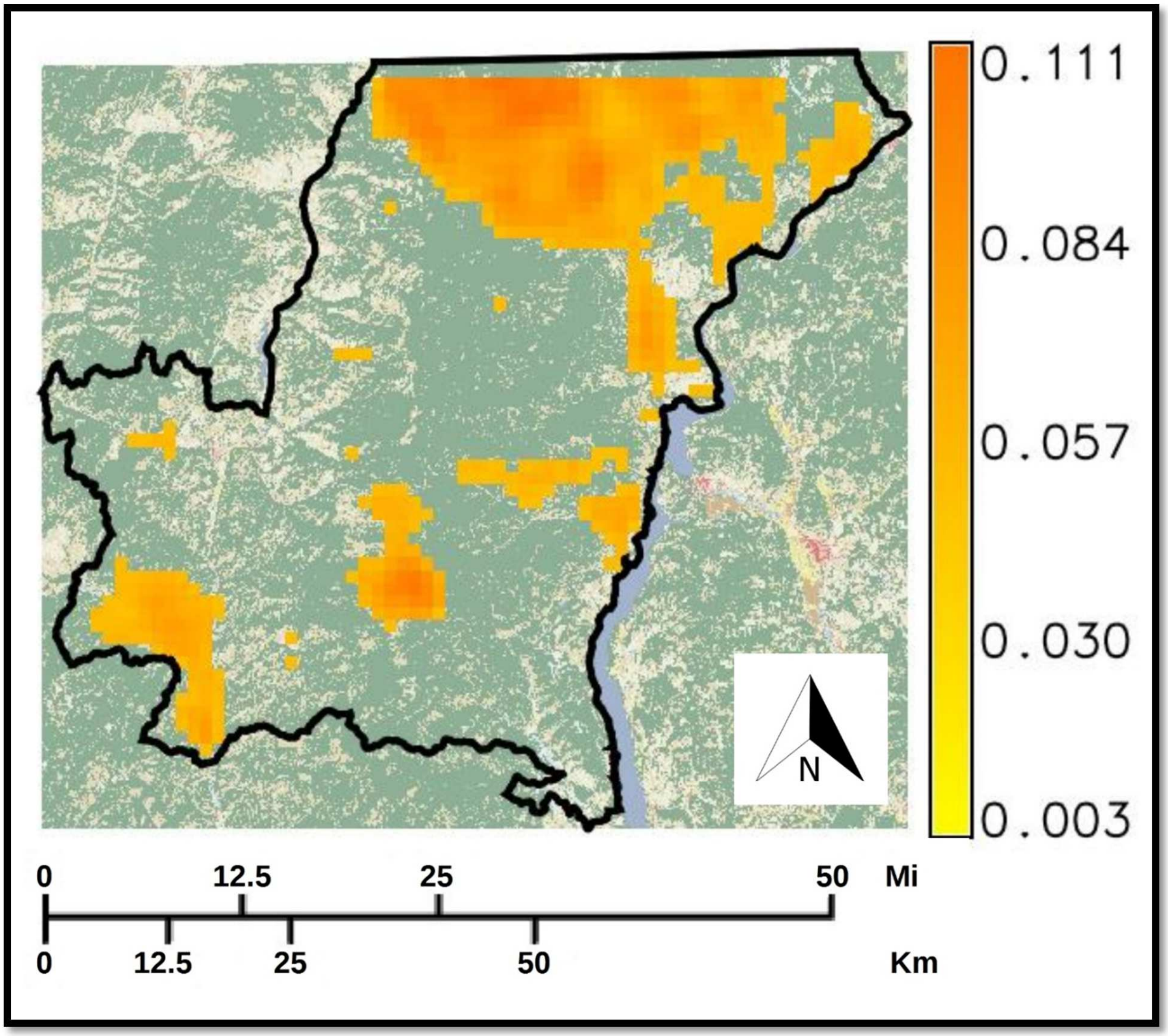


Figure 14. Areas where PGIS participants (n=37) felt that fuels treatments should be avoided on the Colville National Forest. The value to the right of the map represents the percent of people (rescaled to a 0-1 scale) that identified a particular location of the study area as a place where fuels treatments should be excluded.

APPENDICES

Appendix 1. Fuels Data Collection Sheets

FIRE-MON data collection sheets used for this study.

Plot Description (PD) Form

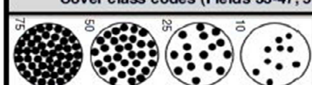
Geopspatial Position	Field 13	Coordinate System	UTM / Lat-Long
	Field 16	Easting	
	Field 17	Northing	
	Field 18	Zone	
	Field 19	Datum	
	Field 20	GPS Error	
	Field 21	Error Units	
Biophys S	Field 22	Elevation	
	Field 23	Aspect	
	Field 24	Slope %	
Tree Cover	Field 33	Total Tree Cover	
	Field 34	Seedling Ht <4.5ft	
	Field 35	Sapling Tree <5in	
	Field 36	Pole 5 - 9in	
	Field 37	Medium 9 - 21in	
	Field 38	Large 21 - 33in	
	Field 39	Very Large >33in	
Herb and Shrub Cover	Field 40	Total Shrub	
	Field 41	Low Shrub	
	Field 42	Medium Shrub	
	Field 43	Tall Shrub	
	Field 44	Graminoid	
	Field 45	Forb	
	Field 46	Fern	
	Field 47	Moss & Lichen	
Composition	Field 48	Up Dom Spp 1 (>10ft)	
	Field 49	Up Dom Spp 2 (>10ft)	
	Field 50	Mid Dom Spp 1 (3-10 ft)	
	Field 51	Mid Dom Spp 2 (3-10 ft)	
	Field 52	Low Dom Spp 1 (<3ft)	
	Field 53	Low Dom Spp 2 (<3ft)	
	Field 54	Potential Veg ID	
	Field 55	Potential Lifeform	

Field Info	Field 5	Examiner		
	Field 6	Units	m	eng
	Field 7	Plot Radius	37.2ft | 52.7ft | _______	
Photos	Direction	N S E W	Number	
	Direction	N S E W	Number	
	Center	Fuels	Number	
Fuel Charact.	Field 66	Suface Fuel Model		
	Field 68	Stand Ht (ft)		
	Field 69	Canopy Fuel Base Ht (ft)		
	Field 70	Canopy Cover		

Reg ID		JC		Plot ID	
Project ID		CV2020		Date	
Field 9	Plot Type	M C	Field 10	Sample Event	P__ R__ IV
Crew					
Camera:					
GPS:					
Notes:					

Code	Potential lifeform
AQ	Aquatic—Lake, pond, bog, river
NV	Nonvegetated—Bare soil, rock, dunes, scree, talus
CF	Coniferous upland forest—Pine, spruce, hemlock
CW	Coniferous wetland or riparian forest—Spruce, larch
BF	Broadleaf upland forest—Oak, beech, birch
BW	Broadleaf wetland or riparian forest—Tupelo, cypress
SA	Shrub dominated alpine—Willow
SU	Shrub dominated upland—Sagebrush, bitterbrush
SW	Shrub dominated wetland or riparian—Willow
HA	Herbaceous dominated alpine—Dryas
HU	Herbaceous dominated upland—grasslands, bunchgrass
HW	Herbaceous dominated wetland or riparian—ferns
ML	Moss or lichen dominated upland or wetland
OT	Other potential vegetation lifeform
X	Did not assess

Cover class codes (Fields 33-47, 56-65)



Code	% Cover
0	0
0.5	>0 – 1
3	>1 – 5
10	>5 – 15
20	>15 – 25
30	>25 – 35
40	>35 – 45
50	>45 – 55
60	>55 – 65
70	>65 – 75
80	>75 – 85
90	>85 – 95
98	>95 – 100

Tree size class

Codes	English	Metric
TO	Total cover	Total cover
SE	Seedling (<1 inch DBH or <4.5 ft height)	Seedling (<2.5 cm DBH or <1.5 m height)
SA	Sapling (1.0 inch–< 5.0 in. DBH)	Sapling (2.5–<12.5 cm DBH)
PT	Pole tree (5.0 inches–<9.0 in. DBH)	Pole tree (12.5–<25 cm DBH)
MT	Medium tree (9.0 inches–<21.0 in. DBH)	Medium tree (25–<50 cm DBH)
LT	Large tree (21.0 inches–<33.0 in. DBH)	Large tree (50–<80 cm DBH)
VT	Very large tree (33.0+ inches DBH)	Very large tree (80+ cm DBH)
NA	Not applicable	Not applicable

Shrub/herb size class

Codes	English	Metric
TO	Total cover	Total cover
SM	Small (<0.5 ft height)	Small (<0.15 m height)
LW	Low (0.5–<1.5 ft height)	Low (0.15–<0.5m height)
MD	Medium (1.5–<4.5 ft height)	Medium (0.5–<1.5 m height)
TL	Tall (4.5–<8 ft height)	Tall (1.5–<2.5 m height)
VT	Very tall (8+ ft height)	Very tall (2.5+ m height)
NA	Not applicable	Not applicable

Species Composition (SC) Form

Examiner:______________ SC Page ___ of _____

Field 1

Species ID Level: __________

Plot Number: _________

Date: ____/____/______

Registration Code: JC

Project Code: CV2020

Notes: only list species with at least 5% cover

	Field 2	Field 3	Field 4	Field 5	Field 6		Field 2	Field 3	Field 4	Field 5	Field 6		Field 2	Field 3	Field 4	Field 5	Field 6
Quadrat	Species Code	Status	Size class	Cover	Height ft	Quadrat	Species Code	Status	Size class	Cover	Height ft	Quadrat	Species Code	Status	Size class	Cover	Height ft
5-Center																	

TreeData (TD) Form

Macroplot size: 0.1 ac	37.2ft	52.7 ft	
Microplot size(seedlings): 0.01ac	11.8ft radius		
Snag plot size: 0.1 ac	37.2ft	52.7 ft	
Breakpoint Dia: 5.0in			

Plot Number: _________
Date: ___/___/_____
Reg. Code: JC
Project Code: CV2020
Crew:

Mortality Codes

F	Fire
I	Insect
D	Disease
A	Abiotic
H	Harvest
U	Unknown
X	Did not assess

Crown classes

- **O – Open grown:** tree not near any other tree
- **E – Emergent:** crown is totally above canopy of stand
- **D – Dominant:** crown receives light from at least 3-4 directions
- **C – Codominant:** crown receives light from atleast 1-2 directions
- **I – Intermediate:** crown only receives light from the top
- **S – Suppressed:** crown shaded and underneath stand canopy.

TD Table 1-Mature Trees (Macroplot) & Saplings

Trees > Breakpoint Diameter of 5.0in DBH											Saplings <5in DBH & HT >4.5ft				
Field 5	Field 6	Field 7	Field 8	Field 9	Field 11	Field 12	Field 13	Field 15	Field 16	Field 17	Field 24	Field 25	Field 27	Field 28	Field 29
Tag Number	Species	Tree Status	DBH (in)	Height (ft)	Crwn LiveBase Ht (ft)	Crown Class	Cored (Y/N)	Decay Class	Mortality Code	Damage Code	Diameter Class (in)	Species	Count	Average Height (ft)	Avg Crown Ratio (%)

Sapling DBH	Class
0 - 1in	0.5
>1 - 2in	1.5
>2 - 3in	2.5
>3 - 4in	3.5
>4 - 5in	4.5

Microplot Photoload and Fuel Data Form

Registration Code: JC
Project Code: CV2020
Plot Number:
Date: ____/____/______

Fuels Method	
Photoload	
Lengths	
Other:____________	

Examier:

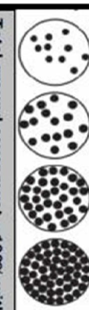
Fuels = 1m x 1m
Seedlings = 2m x 2m

Notes:

Class	Seedling ht
0.2	< 0.5 ft
1	0.5 - 1.5 ft
2	1.5 - 2.5 ft
3	2.5 - 3.5 ft
4	3.5 - 4.5 ft

Ground Cover %	Bare Soil	Gravel	Rock	Litter & Duff	Wood	Moss& Lichen	Char Grnd	Ash	Basal Veg	Water
5-Center										
1-North										
2-East										
3-South										
4-West										

Total ground cover must = 100% with rounding



Code	% Cover
0	0
0.5	>0 – 1
3	>1 – 5
10	>5 – 15
20	>15 – 25
30	>25 – 35
40	>35 – 45
50	>45 – 55
60	>55 – 65
70	>65 – 75
80	>75 – 85
90	>85 – 95
98	>95 - 100

Photoload	1 hour	10 hour	100 hour	Shrub & Herb	Shrub	Herb	Understry Fuels	Woody Live	Woody Dead	Herb Live	Herb Dead	Duff & Litter	4m 13.1f	5m 16.4f
5-Center				*Load kg/m²*			% cover					Duff cm		
							Ht (ft)					Litter cm		
1-North				*Load kg/m²*			% cover					Duff cm		
							Ht (ft)					Litter cm		
2-East				*Load kg/m²*			% cover					Duff cm		
							Ht (ft)					Litter cm		
3-South				*Load kg/m²*			% cover					Duff cm		
							Ht (ft)					Litter cm		
4-West				*Load kg/m²*			% cover					Duff cm		
							Ht (ft)					Litter cm		

Seedlings	5-Center				1-North				2-East				3-South				4-West			
2mx2m	HT Class	Spp Code	Count	CR %	HT Class	Spp Code	Count	CR %	HT Class	Spp Code	Count	CR %	HT Class	Spp Code	Count	CR %	HT Class	Spp Code	Count	CR %
Ht < 4.5ft																				

Extra seedlings

Quadrat	Ht Class	Spp Code	Count	CR %

Appendix 2. Understory Plant Species List

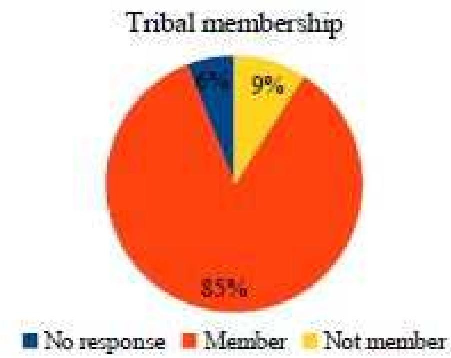
Species list of the 58 understory plant species observed within the 15 paired plots. Nomenclature follows the USDA Plants Database.

Scientific Name	**Common Name**	**USDA Code**
Achillea millefolium L.	Common yarrow	ACMI2
Amaranthus retroflexus L.	Redroot amaranth	AMRE
Amelanchier alnifolia (Nutt.) Nutt. ex M. Roem. Var. *alnifolia*	Saskatoon serviceberry	AMALA
Antennaria Gaertn.	Pussytoes	ANTEN
Arctostaphylos uva-ursi (L.) Spreng. Var. *adentotricha* Fernald & J.F. Macbr.	Kinnikinnick	ARUV
Argentina anserina (L.) Rydb.	Silverweed cinquefoil	ARAN7
Arnica cordifolia Hook.	Heartleaf arnica	ARCO9
Athyrium Roth	Ladyfern	ATHYR
Berberis aquifolium Pursh	Hollyleaved barberry	BEAQ
Buxus L.	Boxwood	BUXUS
Calamagrostis rubescens Buckley	Pinegrass	CARU
Calyptridium roseum S. Watson	Rosy pussypaws	CARO
Carex garberi Fernald	Elk sedge	CAGA3
Castilleja Mutis ex L. f.	Indian paintbrush	CASTI2
Ceanothus sanguineus Pursh redstem ceanothus	Redstem ceanothus	CESA
Chimaphila umbellate (L.) W.P.C. Barton ssp. *occidentalis* (Rydb.) Hultén pipsissewa	Prince's Pine	CHUMO2
Cirsium vulgare (Savi) Ten.	Bull Thistle	CIVU
Clintonia uniflora (Menzies ex Schult. & Schult. F.) Kunth	Bride’s bonnet	CLUN2
colinzia linearus A. Gray	Narrowleaf blue eyed Mary	COLI
Collinsia Nutt.	Blue eyed Mary	COLLI
Collinsia parryi A. Gray	Parry’s blue eyed Mary	COPA2
Crepis L.	Hawksbeard	CREPI
Cryptantha Lehm.. Ex G. Don	Cryptantha	CRYPT
Epilobium angustifolium L.	Fireweed	EPAN2
Festuca idahoensis Elmer	Idaho fescue	FEID
Fragaria L.	Strawberry	FRAGA
Galium odoratum (L.) Scop.	Sweetscented bedstraw	GAOD3
Hieracium albiflorum Hook.	White hawkweed	HIAL2
Hieracium aurantiacum L.	Orange hawkweed	HIAU
Lappula Moench	Stickseed	LAPPU
Linnaea borealis L. ssp. *longiflora* (Torr.) Hultén	Longtube twinflower	LIBOL2

Lily Spp.	Lily	
Lupinus L.	Lupine	LUPIN
Lupinus latifolius Lindl. Ex J. Agardh	Broadleaf lupine	LULA4
Maianthemum racemosum (L.) Link	Feathery false lily of the valley	MARA7
Melampyrum L.	Cowwheat	MELAM2
Menziesia ferruginea Sm.	Rusty menziesia	MEFE
Moehringia macrophylla (Hook.) Fenzl	Largeleaf sandwort	MOMA3
Montia L.	Minerslettuce	MONTI
Oxyria digyna (L.) Hill	Alpine mountainsorrel	OXDI3
Paxistima myrsinites (Pursh) Raf.	Oregon boxleaf	PAMY
Pedicularis bracteosa Benth.	Bracted lousewort	PEBR
Poa pratensis L.	Kentucky bluegrass	POPR
Rosa gymnocarpa Nutt.	Dwarf rose	ROGY
Silene douglasii Hook. Var. *douglasii*	Douglas's catchfly	SIDOD
Spiraea L.	Spirea	SPIRA
Stachys byzantina K. Koch	Woolly hedgenettle	STBY
Streptopus amplexifolius (L.) DC.	Claspleaf twistedstalk	STAM2
Symphoricarpos albus (L.) S.F. Blake	Common snowberry	SYAL
Taraxacum officinale F.H. Wigg.	Common dandelion	TAOF
Thalictrum occidental A. Gray	Western meadow-rue	THOC
Trifolium grandiflorum (Michx.) Salisb.	White trillium	TRGR4
Trifolium repens L.	White clover	TRRE3
Vaccinium myrtilloides Michx.	Velvetleaf huckleberry	VAMY
Verbascum thapsus L.	Common mullein	VETH
Violet Spp.		
Zigadenus spp.	Death Camas	ZIGAD

Appendix 3. PGIS Demographics

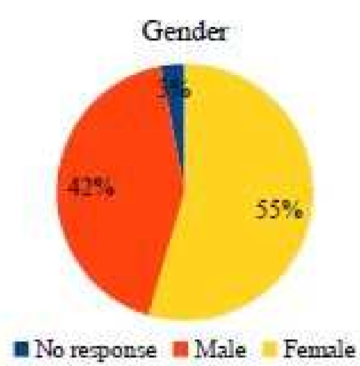
What tribe(s) are you a member of or a descendant from?



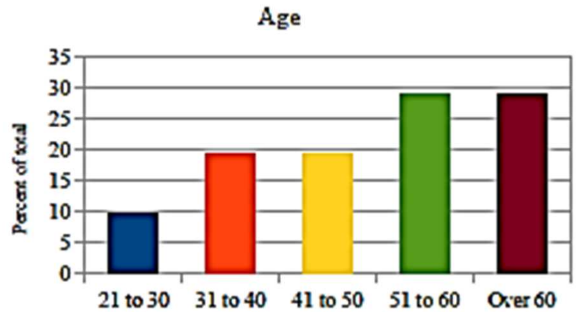
Tribal memberships and/or quanta indicated:

- Confederated Colville Tribes (undefined).
- Registered as official bands on the Colville Indian Reservation: Colville, Sinixt (Arrow Lakes), San Poil, Okanogan, Entiat, Chief Joseph Band of Nez Perce, Wenatchi, Moses-Columbia, Nespelem, Palus.
- Other Tribes: Yakama, Coeur d'Alene, Umatilla, Salish-Kootenai.

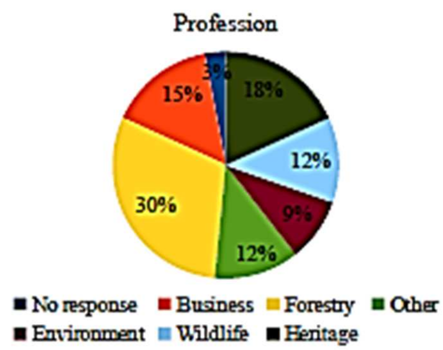
What is your sex?



Please mark the category that best reflects your age as of:



What is or was your profession?



Demographic and thematic modules

		Did online	Did offline	Did not do	
Map module	Did	24	6	7	**37**
	Did not do	3	0	0	**3**
		33		**7**	**40**

Table 1. Participation in the modules.

Did map question 1

		Yes	No	
Did map question 2	Yes	15	1	**16**
	No	21	0	**21**
		36	**1**	

Table 2. Participation in the map questions.

Appendix 4. PGIS Questions

The consultation was implemented as two modules on a Map-Me interface. We started with the demographic and thematic questions first and then followed up with the map questions. These pictures are just snap-shots of what the participants saw on the online version.

Forest Vision 2020 Collaborative Forest Landscape Restoration Program

Effects of fuels reduction treatments on cultural uses of the Colville National Forest

2015 scoping module

Form Number CO-15-00001

University of Idaho USDA WRi Wildland Research Institute University of Leeds

Effects of fuels reduction treatments on cultural uses of the Colville National Forest: 2015 consultation

Form Number CO-15-00001

Introduction to this consultation

Fuels reduction treatments can be effective tools for managing wildfires, including wildfire effects on forests and all of the things that people value. However, the types of treatments and where they are placed on the landscape can have a variety of benefits and consequences. The USDA Forest Vision 2020 Collaborative Forest Landscape Restoration Program would like your help in determining which types of treatments and where they are placed on the Colville National Forest would be most useful for you. Your participation will remain anonymous, and privacy data requirements will be met in order to protect your values and uses in the forest. All of the information provided by Colville tribal members or representatives in this module is confidential and owned by the Confederated Tribes of the Colville Reservation.

Authors

The questions have been designed by Fernando Sánchez-Trigueros (University of Leeds / US Forest Service) and Monique Wynecoop (US Forest Service / University of Idaho) under the supervision of Penelope Morgan (University of Idaho), Travis Paveglio (University of Idaho) and Alan Watson (US Forest Service), and approved for its implementation on the Colville Indian Reservation by the Colville Natural Resources Committee and the Colville Cultural Committee in October and November of 2015.

Directions for the completion of the consultation

- The consultation consists of two major parts: this module and an online, Internet-based mapping module.
- Text boxes in the modules are not limited by its default extent. Feel free to expand your answer as much as needed.
- Choice-based questions in the modules can be answered by any sign that unambiguously chooses one (and only one) of the possible responses.
- Once completed, please send this form back to: moniquedwynecoop@fs.fed.us
- After completing this form, please access the World Wide Web to complete the map module online, which will allow you to identify places on the Colville National Forest where you would like to discuss the application of fuels treatments: http://map-me.org/sites/FuelsMap .
- At the beginning of the mapping module, you will be requested to enter the Form Number that appears on the upper right end of this document. This step is very important as it will allow us to join your answers placed in different modules.
- For further assistance, please do not hesitate to contact Monique Wynecoop (moniquedwynecoop@fs.fed.us) or Fernando Sánchez-Trigueros (f.sancheztrigueros@leeds.ac.uk).

University of Idaho USDA WRi UNIVERSITY OF LEEDS

Effects of fuels reduction treatments on cultural uses of the Colville National Forest: 2015 consultation

Form Number CO-15-00001

I. Demographic details

1. What tribe(s) are you a member of or a descendant from, if any?

2. What is your sex?

    - Female
    - Male

3. Please mark the category that best reflects your age as of:

    - Below 21
    - 21 to 30
    - 31 to 40
    - 41 to 50
    - 51 to 60
    - Over 60

4. What is or was your profession?

5. Please, provide your home ZIP code:

University of Idaho USDA WRi UNIVERSITY OF LEEDS

Effects of fuels reduction treatments on cultural uses of the Colville National Forest: 2015 consultation

Form Number CO-15-00001

II. Uses of the Colville National Forest

6. Do you go hunting on the Colville National Forest?

   - Yes
   - No

7. Do you go fishing on the Colville National Forest?

   - Yes
   - No

8. Do you gather plants and other natural resources on the Colville National Forest?

   - Yes
   - No

9. Do you use off-road and all-terrain vehicles on the Colville National Forest?

   - Yes
   - No

10. Do you gather firewood on the Colville National Forest?

    - Yes
    - No

11. If you use the Colville National Forest for other purposes, could you explain them?

Form Number CO-15-00001

III. Use of mechanical fuel treatments for understory thinning

12. How effective or ineffective do you think small-size mechanical fuel treatments (i.e. understory thinning) are for managing the following activities on CNF lands?

	Very ineffective	Somewhat ineffective	Neither ineffective or effective	Somewhat effective	Very effective
A) Hunting					
B) Fishing					
C) Gathering of plants and other natural resources					
D) Use of off-road and all-terrain vehicles					
E) Firewood gathering					

13. Could you explain your answer concerning hunting?

14. Could you explain your answer concerning fishing?

15. Could you explain your answer concerning the gathering of plants or other natural resources?

Form Number CO-15-00001

16. Could you explain your answer concerning the use of off-road and all-terrain vehicles?

17. Could you explain your answer concerning firewood gathering?

18. What other uses of CNF lands would be affected by small-size mechanical fuel treatments?

19. How effective or ineffective do you think small-size mechanical fuel treatments would be for managing the above uses on CNF lands?

- Very ineffective
- Somewhat ineffective
- Neither ineffective or effective
- Somewhat effective
- Very effective

20. Could you explain your last answer?

Form Number CO-15-00001

IV. Use of prescribed fire treatments for understory thinning

21. How effective or ineffective do you think prescribed fire treatments (i.e. management-ignited fire) are for managing the following activities on CNF lands?

	Very ineffective	Somewhat ineffective	Neither ineffective or effective	Somewhat effective	Very effective
A) Hunting					
B) Fishing					
C) Gathering of plants and other natural resources					
D) Use of off-road and all-terrain vehicles					
E) Firewood gathering					

22. Could you explain your answer concerning hunting?

23. Could you explain your answer concerning fishing?

24. Could you explain your answer concerning the gathering of plants or other natural resources?

Form Number CO-15-00001

25. Could you explain your answer concerning the use of off-road and all-terrain vehicles?

26. Could you explain your answer concerning firewood gathering?

27. What other uses of CNF lands would be affected by prescribed fire treatments?

28. How effective or ineffective do you think prescribed fire treatments would be for managing the above uses on CNF lands?

- Very ineffective
- Somewhat ineffective
- Neither ineffective or effective
- Somewhat effective
- Very effective

29. Could you explain your last answer?

Form Number CO-15-00001

V. Use of naturally occurring wildfires to reduce fuels in the understory and restore ecosystems

30. How effective or ineffective do you think managed naturally occurring wildfires can be for managing the following activities on CNF lands?

	Very ineffective	Somewhat ineffective	Neither ineffective or effective	Somewhat effective	Very effective
A) Hunting					
B) Fishing					
C) Gathering of plants and other natural resources					
D) Use of off-road and all-terrain vehicles					
E) Firewood gathering					

31. Could you explain your answer concerning hunting?

32. Could you explain your answer concerning fishing?

33. Could you explain your answer concerning the gathering of plants or other natural resources?

Form Number CO-15-00001

34. Could you explain your answer concerning the use of off-road and all-terrain vehicles?

35. Could you explain your answer concerning firewood gathering?

36. What other uses of CNF lands would be affected by prescribed fire treatments?

37. How effective or ineffective do you think managed naturally occurring wildfires would be for managing the above uses on CNF lands?

- Very ineffective
- Somewhat ineffective
- Neither ineffective or effective
- Somewhat effective
- Very effective

38. Could you explain your last answer?

Thank you for completing this module of the consultation

To complete your participation, access the online, Internet-based mapping module at

http://map-me.org/sites/FuelsMap

either by clicking on the above hyperlink, or by copying it and pasting it on your preferred browser. Please keep your Form Number at hand (it appears on the upper right end of this document), as it will be requested by the mapping module.