Integrative Whitebark Pine Ecosystem Restoration Initiative

COA-F18-W-2472

Prepared for: Fish and Wildlife Compensation Program

Prepared by: Randy Moody MSc, RPBio and Ken Wright on behalf of the Lillooet Tribal Council

Prepared with financial support of the Fish and Wildlife Compensation Program on behalf of its program partners BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and public stakeholders.

31-March-2018

FWCP Fish & Wildlife COMPENSATION PROGRAM

Executive Summary

Whitebark pine (*Pinus albicaulis*) is a blue-listed species in British Columbia and listed as endangered under the Species at Risk Act (SARA) primarily due to white pine blister rust, mountain pine beetle, fire suppression, and global climate change. This project aligns with the Bridge-Seton Species Action Plan (2017); including the following:

- Action 37: Inventory and restoration for at-risk (e.g., SARA-listed, red- and blue-listed) and/or culturally important plant species and ecological communities; and
- Action 38: Build upon previously-funded Whitebark Pine work.

In early summer we surveyed two locations for late summer restoration implementation. This included a survey of the Mount McLean fire for planting suitability and a survey of the Blustry Mountain area for competition removal locations and planting of a rust screening field trial.

A total of 2,100 whitebark pine seedlings were planted on Mount McLean over a total area of 5.18 ha in early September 2017. Seedlings were planted using a combination of paid and volunteer planters from the community. The number of seedlings planted was lower than planned 7,000 seedlings over 18 ha due to funding shortfalls and limitation in accessing other sites due to fire hazards.

The competition removal and and field based rust screening trial planned for Blustry Mountain could not be completed as fire hazard levels were too high to permit field work in the area. FWCP was funding site layout and the competition removal work was to be completed in-kind. Additional funding and in-kind labour has been secured to complete these phases in 2018.

New recommendations from the project implementation in 2017 include:

- Conduct sustained planting to ensure certainty for nursery producers and encourage a broader market for seedlings to provide a good business case for continued production;
- Continue with outreach-based restoration;
- Focus restoration efforts at sites with high levels of whitebark pine decline;
- Seek multi-year funding to limit funding caused shortfall in project implementation;
- Where conditions permit and is appropriate, implement field work as early in the season as possible to limit fire condition restrictions, which are most likely to occur later in the season;
- Identify ways to expand outreach, these may include: dove-tailing presentations with local bear biologists, visits to the local nursery, dedicated visits to more remote communities, and extending invitations to more field work.

Table of Contents

Executive Summary 2
1. Introduction 4
   1.1. Species Description 4
   1.2. Threats and Conservation Status 6
   1.3. Pathways to Species Recovery 7
   1.4. Goals and Objectives 8
2. Methods 9
3. Results 10
4. Discussion 13
5. Recommendations 20
6. References 21

1. Introduction

Whitebark pine (*Pinus albicaulis*) is a blue-listed species in British Columbia and listed as endangered under the Species at Risk Act (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (BCDC, 2002; COSEWIC, 2010). The following outlines a brief description of whitebark pine, its distribution and habitat, ecological importance, and threats.

This project aligns with the Bridge-Seton Species Action Plan (2017); including the following:

- Action 37: Inventory and restoration for at-risk (e.g., SARA-listed, red- and blue-listed) and/or culturally important plant species and ecological communities; and
- Action 38: Build upon previously-funded Whitebark Pine work.

1.1. Species Description

Whitebark pine is a long-lived species, surviving more than 500 years and occasionally greater than 1000 years (COSEWIC, 2010). Whitebark pine typically grows 5-20m tall with a rounded to irregular crown. Form is dependent on local site conditions and competition levels (COSEWIC, 2010). At treeline and on exposed sites, whitebark tends to take on a stunted and twisted form, ranging in height of 5-10m, whereas in lower elevation, closed-canopy forests, trees take on a straight form and grow up to 20m tall (COSEWIC, 2010).

Whitebark pine is one of three five-needled pines in BC, other species being western white pine (*Pinus monticola)* and limber pine (*Pinus flexilis*). Needles are 3-9cm in length and tend to clump towards the end of branches (COSEWIC, 2010; Parish, 1948). Pollen buds are visible in mid-June to mid-July and are raspberry red in colour, which is easily distinguishable from the yellow-orange pollen buds of western white pine, lodgepole pine, and limber pine (Pigott, 2012). Mature cones are egg-shaped to almost round, and are dark brown to purple in colour, ranging in size of 3-8cm in length. Cones are first produced when the tree is 30-50 years in age and a sizable crop is commonly not produced until the tree is 60-80 years in age (COSEWIC, 2010). Cone production also varies in years, experiencing no to very little production in some years and in others experiencing a mast cone production. Cones are permanently closed and require the bird, Clark's nutcracker (*Nucifraga columbiana*), to break open the cone and cache seeds for seed dispersal. The bark on young whitebark pine trees is thin, smooth, and chalky-white. As the tree ages the bark thickens and forms narrow, brown, scaly plates (COSEWIC, 2010).

Whitebark pine grows on dry to moderately moist sites found in high elevation, upper subalpine habitats ranging from timberline to closed subalpine in western North America. Whitebark occurs most abundantly on drier, exposed south-facing slopes near treeline. Specifically, in Canada, whitebark pine reaches its northernmost extent at approximately 55°N in the Coast Mountains and at about 54°N in the Rocky Mountains between the British Columbia and Alberta border (Figure 2; COSEWIC, 2010). Elevations vary in Canada, with trees commonly found at 1950m to 2250m at the Canada-USA border and from 1000m to 1600m in northcentral BC (COSEWIC, 2010).

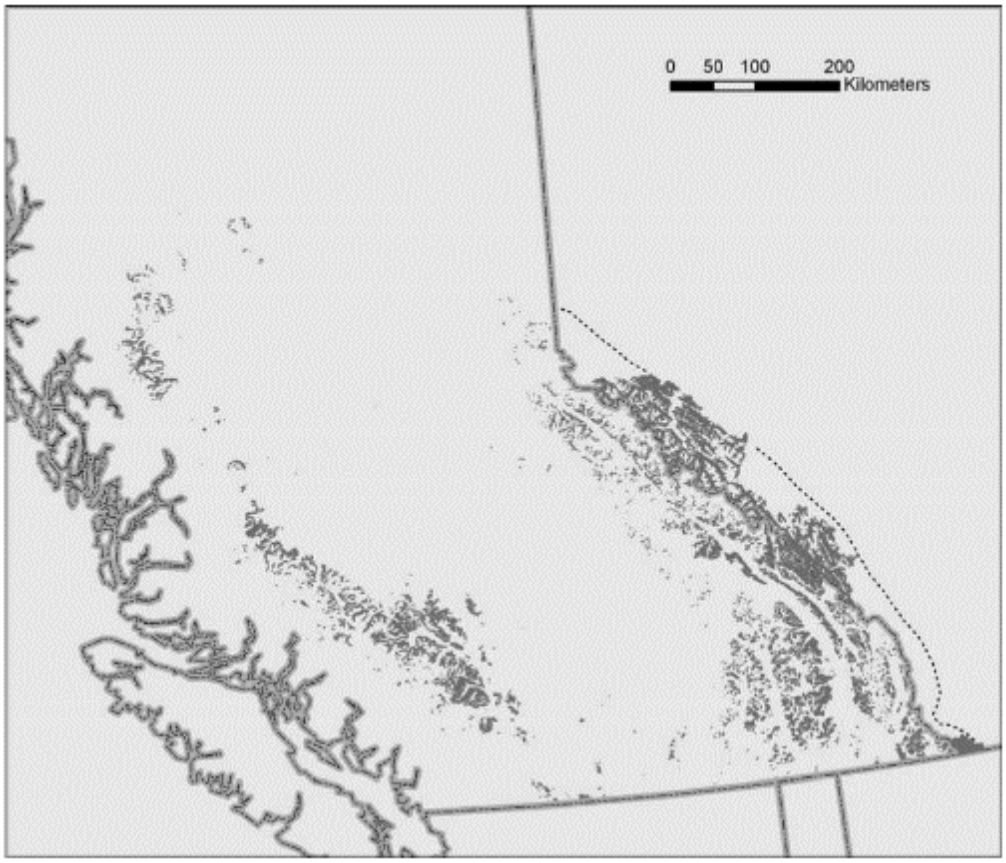

Figure 2. Canadian range of Whitebark Pine. Dotted line in Alberta indicates eastern edge of range (COSEWIC , 2010).

Ecological Importance

Whitebark pine is classed as both a foundation and keystone species. It plays a very important ecological role, growing in some of the most inhospitable climates, tolerating high wind and snow, with relatively little soil or water (Pigott, 2012; COSEWIC, 2010). On these sites whitebark pine stabilizes soil and rock, reducing erosion; slows the progression of snowmelt, decreasing flooding at lower elevations; and facilitates the survival and growth of conifers and understory vegetation by creating favourable habitat for establishment (COSEWIC, 2010). Further, whitebark pine is very important for wildlife, particularly Clark's nutcracker, red squirrel, and grizzly and black bears. Whitebark pine seeds are highly nutritious, containing about 52% fat, 21% carbohydrates and 21% protein, which make them a prime choice to store as a winter food source for the nutcracker and red squirrel and provide a rich source of calories for bears building fat deposits for winter hibernation (Pigott, 2012).

Clark's Nutcrackers, like other members of the Corvid family are known as scatter-hoarders for their propensity to store abundant seed crops in spatially distributed cache sites across the landscape. As many of the caches are never recovered, this seed caching behaviour leads to mutualism, whereby the tree (ie, Whitebark Pine) benefits from the dispersal services provided by the nutcracker. The ecological

consequences of this bird-pine mutualism are very profound indeed, setting the stage for a foundation ecosystem like no other in this part of the world.

1.2. Threats and Conservation Status

Despite its important ecological role, whitebark pine populations are rapidly declining, largely unchecked, due to four main agents:

1) **White Pine Blister Rust**
   White pine blister rust is caused by the fungus *Cronartium ribicola,* which was accidentally introduced to British Columbia in 1910 from Europe (Pigott, 2012). The fungus requires alternate hosts from the *Ribes* (currant and gooseberry), *Pedicularis* (lousewort), or *Castilleja* (Paintbrush) genera. Fungal spores are released from the alternate hosts in the spring and land on the needles of the tree (COSEWIC, 2010). The fungus enters through the stomata on the needles of the pine tree and travel down the branch to the main stem where it girdles and eventually kills the tree (Pigott, 2012).

2) **Mountain Pine Beetle**
   Mountain pine beetle (*Dendroctonus ponderosae*) can kill and reproduce in whitebark pine. Trees already weakened by white pine blister rust are more susceptible to mountain pine beetle attack (Alberta Whitebark and Limber Pine Recovery Team, 2014).

3) **Fire Suppression**
   Whitebark pine is a poor competitor. Under natural fire regimes, low intensity fires would burn through stands, removing the understory, which would allow whitebark pine to thrive (COSEWIC, 2010). As well, Clark's nutcracker uses burned sites for seed caching, allowing for rapid regeneration of whitebark pine (COSEWIC, 2010). Years of fire suppression have allowed shade tolerant species to dominate whitebark pine habitats, limiting whitebark's ability to establish and survive on sites.

4) **Climate Change**
   Increasing global temperatures will require whitebark pine to migrate to areas of suitable climate and adapt to changed climatic conditions or be extirpated (COSEWIC, 2010). Warming temperatures are expected to increase competition as lower elevation species migrate upslope which will increase tree stress, potentially making it more susceptible to blister rust and mountain pine beetle attack.

1.3. Pathways to Species Recovery and Local Recovery Efforts

To restore whitebark pine, a multi-pronged approach is required to address the multiple threats it faces. Several actions have been implemented over-time to address these threats including direct action in the Lillooet Region (Table 1).

Table 1. Summary of actions to address threats and how threats are being mitigated in the Lillooet Region.

Threat	Actions to Address Threat	Lillooet Regional Context
White Pine Blister Rust	Collect seed from the healthiest trees in highly infected populations (Putative Resistance); Plant putatively resistant seedlings in suitable habitat; Screen seedlings for resistance to rust; and Develop breeding programs once resistance to rust is confirmed.	Seed has been collected from putatively resistant parents over several years. Seedlings produced and planted from these parents. High rust areas have been identified as sites to field screen for rust resistance.
Mountain Pine Beetle	Protect plus trees (putative resistance) from mountain pine beetle using acceptable methods such as anti-aggregation pheromones.	Mountain pine beetle has largely passed through area with low whitebark pine mortality observed.
Fire Suppression	Conduct prescribed burning in regions where fire is artificially absent from the landscape. Use mechanical means of competition removal to simulate fire effects of reducing competition. Survey burn areas and support recruitment by planting seedlings.	Large scale wildfires have impacted large areas from Lillooet north up the Yalakom Valley and somewhat west and east of this region. Xaxli'p Community Forest crews are experimenting with the application of mechanical restoration. Surveys have been conducted in some burned areas and identified that natural recruitment levels are low to non-existent.
Global Climate Change	Ensure the presence whitebark pine populations at the latitudinal and elevation limits of whitebark pine. Conduct assisted migration at these limits.	Restoration of mountain top ecosystems at Porcupine Ridge (2016) and Mount McLean (this project)

1.4. Goals and Objectives

Whitebark pine is a Federally Endangered species under SARA that, due to its life history and the range of threats impacting it, will require a multi-pronged approach to recovery. This project consists of multiple recovery-based goals including:

1) Re-establish whitebark pine in wildfire areas;
2) Reduce competition levels around healthy whitebark pine trees; and
3) Assist in identifying blister rust resistant stock.

2. Methods

The methods and approach employed to implement this project were developed to address the main threats; these activities include:

a) Planting: Planting was implemented by first pre-surveying the proposed planting area on Mount McLean in mid-summer. During this survey, features such as potential hazards, natural stocking levels, and logical planting boundaries were identified. The entire boundary of the planting unit was mapped with GPS and ribboned with flagging tape to identify the boundaries. Planting was also planned for Big Dog and potentially Yalakom River; these sites were removed from the planting plan as high fire hazards limited vehicle access to these locations. The pre-project target was planting 7,000 seedlings over 18 ha. The seedlings planted were generated from seed collected from 'putatively resistant parents' these are parents that display some forms of resistance to blister rust (they are the healthiest in the population) but have not been formally tested for resistance to rust.

b) Competition Removal: Removal of competition from around healthy whitebark pine trees was planned for Blustry Mountain. The process involved identifying and marking healthy whitebark pine trees and removing competition of a similar height from within an approximate tree-length radius from around the tree.

c) Field Based Rust Trials: Planting seedlings in monitoring transects is one means to monitor survival and determine if parent trees from the seedlings may have some form of resistance to blister rust that is being displayed in progeny. Seedling from healthy parents growing in high rust locations in the region were selected for these trials. These trials were planned for the Blustry Mountain region, as rust levels here are the highest in the region, a condition which would ensure seedlings are inoculated by rust spores over time; plus the site is easily accessed by foot allowing for cost-effective monitoring. The pre-project target was planting 30 trees from 20 parents for a total of 600 seedlings planted in trials.

d) Outreach: Outreach based restoration is a key component of this project to maximize the area restored and to continue to develop an understanding and appreciation for whitebark pine. In previous years local outreach was conducted with the St'at'imc Nation, Lillooet Naturalist Society, and Industry.

3. Results

a) Planting: In September 2017, approximately 2100 whitebark pine seedlings were planted in a burned area on Mount McLean, directly northwest of Lillooet. A total of 5.18 ha was planted for a total planted density of 400 seedlings/ha (Figure 1). These seedlings were purchased from Skimikin Nursery (1400) and Splitrock (700); seedling from Skimikin were used as this nursery has experience growing seedlings and in 2015-16 seeds were sent there as a safeguard against failures at Splitrock, which was still developing expertise in whitebark production.

Planting was conducted by a combination of paid planters and volunteers. Local volunteers from the St'at'imc First Nation, including Chief Shelly Leech from the T'itq'et Band, assisted with planting.

Access to the site was via helicopter, as a summer reconnaissance visit determined that vehicle and foot access would not work to access the site in an efficient manner, this resulted in higher than planned access costs despite the proximity to Lillooet.

Additional sites planned for planting were dropped from the plan in 2017 due to high fire hazard restricting backcountry access, and poor road conditions. In lieu of planting these sites, additional funds were directed to helicopter support of the Mt McLean Planting.

The planting total and area were below the planned outcome levels of 7,000 seedlings over 18 ha due to insufficient funding from matching funders and additional expenses incurred due to helicopter access only.

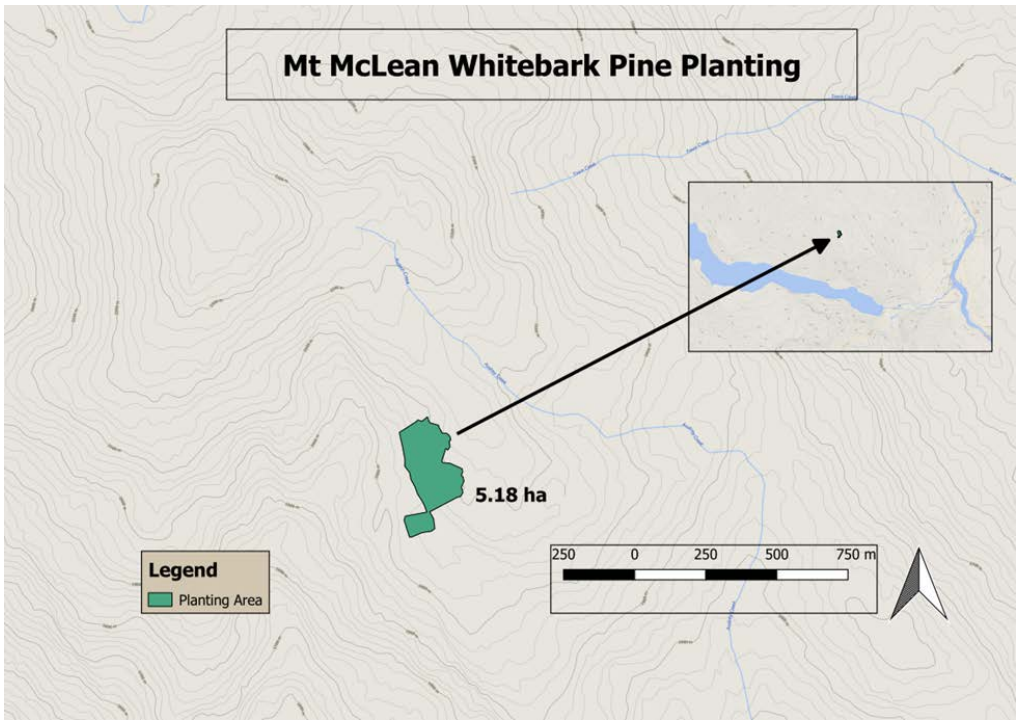

Figure 1. Map showing Mount McLean planting area.

Figure 2. Crew of volunteers that assisted with planting whitebark pine (Photo: Ian Routley).

b) Competition Removal: Competition removal sites were identified at Blustry Mountain. These sites were flagged for field crews to re-visit and remove competition via chainsaw and brush saw. Unfortunately, the fire conditions of summer 2017 prevented the field crew from returning to the site as vehicles and power saw use were prohibited; thus the field work was not completed. The field work at this site was to be completed in-kind by the Xaxli'p Band's

Forestry Crew, fortunately this crew still has funding in place for 2018 and will complete the already identified thinning area early in the season to limit any fire related work stoppages.

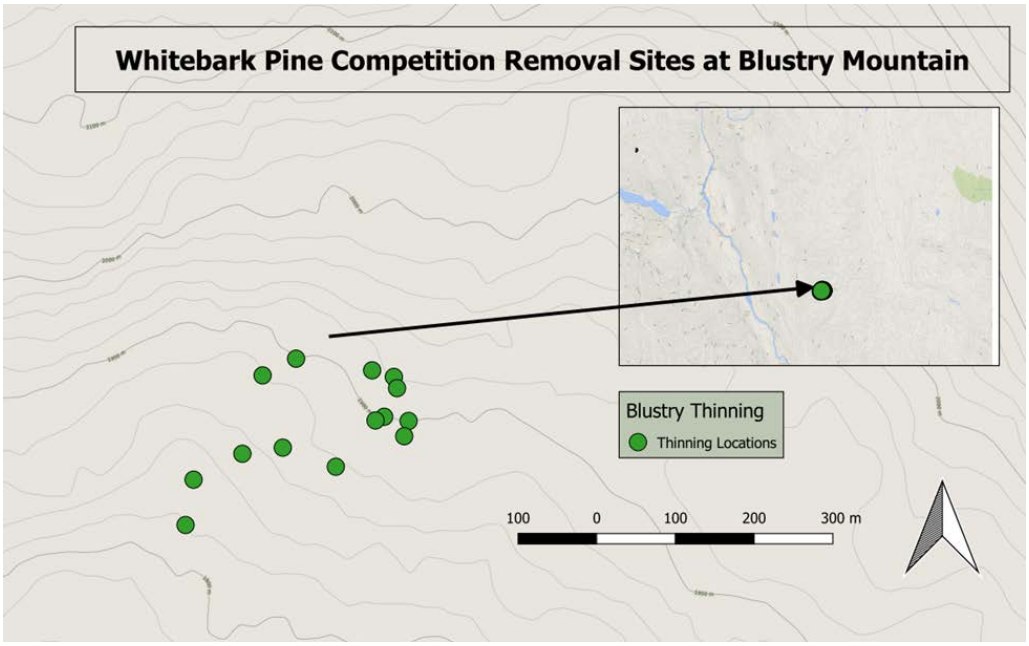

Figure 3. Proposed competition removal sites at Blustry Mountain.

c) Field Based Rust Screening: Due to high fire hazard, the field-based trial was not planted in 2017. The restoration planting on Mt McLean was able to be planted as it was accessed by helicopter into an old burn area where wildlife risk was lower; the Blustry site was accessed by vehicle and by foot and was closed to access. The seedlings planned for this site were retained in the nursery for planting in 2018.

d) Outreach: In 2017, outreach was field based with a small crew of volunteers who were flown to the planting site. The original plan was to conduct more extensive field-based outreach but the limited access due to vehicle access restrictions resulted in only volunteers who could be accommodated in the helicopter coming to site.

4. Discussion

Seedling Planting

Planting was accomplished over two-days using a combination of paid and volunteer planters. This approach has been utilized at other planting sites in the region including Yalakom and Porcupine Ridge and has proven to be a suitable option to get additional restoration work accomplished. Each year, some form of incentive has been provided to volunteers such as access to backcountry sites, in 2017 the incentive was a helicopter trip to the planting area directly above town. Some volunteers have been constant in their participation and the number of informed individuals in the region has resulted in volunteers on projects being nearly guaranteed as individuals have become concerned about the well-being of whitebark pine.

Despite the success of planting at Mount McLean, the total planted area and number of seedlings planted were well short of proposed targets of 18 ha and 7,000 seedlings planted. This was primarily due to a failure of other cash contributions to materialize, which would have paid for the additional seedlings. Two funders indicated that proposals were successful, but one encountered logistical issues providing funding into Canada (US Based) and another indicated that the proposal was approved but insufficient funds were in place to award all approved projects and this project was placed on a wait list to see if additional funds would be released to support this project. One of these funders indicated full support for 2018 and a proposal was not submitted to the other funder for further work. Due to the inability to plant all of the seedlings in the nursery, 2,000 were sold to another whitebark pine project being implemented in the Chilcotin region north of Lillooet. A large seed collection was conducted in 2016 in the Chilcotin thus about 5,000 seeds required to replace these seedlings will be provided to Splitrock Nursery.

Whitebark pine seedlings are not readily available from nurseries and the supply is generally only created by restoration practitioners who also provide the seed. Seedling production requires two-years to produce a plantable seedling and quality may decrease over longer periods as the roots of these seedlings may grow into the walls of the Styrofoam containers. Due to these issues plus the additional cost of seedling care over time, nurseries generally want certainty that seedlings will be purchased after two-years. Although funding from three agencies was sought, only one was successful this year thus not all seedlings could be purchased creating a risky situation for the nursery, thus some seedlings were sold to another project. If there were multiple regional restoration projects being implemented each year and other groups, such as forest companies, interested in whitebark planting then nurseries could likely produce seedlings each year with greater certainty. Fortunately, Splitrock Nursery has demonstrated an ability to produce whitebark pine seedlings and may consider a broader market for producing this difficult to produce species as they are presently only one of three nurseries in the province that produce whitebark pine seedlings.

In 2018, seedlings may be planted earlier than in other years as they do not require another full season in the nursery prior to planting. This will permit planting in late June or early July as opposed to fall planting done in other years.

Adaptive Management

This project required a high level of adaptive management in 2017 due to high fire hazard and failure of some funding to materialize. Fortunately, the FWCP funded portions of competition removal were completed, however the matching in-kind portion by the Xaxli'p Forestry Crew was not completed. The crew manager has indicated that this portion of work will be completed in 2018 as soon as conditions permit as there is a high level of motivation to gain expertise in whitebark pine recovery work.

The field-based rust trial did not get established as accessing the region at time of planting was not permitted due to high fire hazards. This situation may have been fortunate as drought stress was likely high at the work site and may have resulted in high non-rust seedling mortality. The funds for this portion of work was used to purchase seedlings and support helicopter access for planting on Mount McLean, and funds were sought to ensure establishment of this trial when conditions improved in 2018. Funds from the Forest Enhancement Society and American Forests were confirmed to complete this phase in 2018. Fortunately, these seedlings are ready to be planted early in 2018 and this trial may be established early in the growing season.

Although conditions in summer 2017 limited full completion of the workplan, the most important restoration activity, seedling planting, was accomplished. Further, it was fortunate that several tasks were planned for this project allowing for some flexibility in implementation.

Meeting 2017 and future Objectives

Due to the conditions faced in 2017, many activities were only partially completed thus they will be addressed in 2018. The partial completion of activities was mainly due to fire effects and hazards but the biology and habitat of whitebark pine often results in delays or barriers to the implementation of a streamlined recovery program. These inherent obstacles include:

- Cones are only produced every few years and are somewhat unpredictable thus collecting seed may be difficult.
- Once seed is collected, seedling production takes 2-years in the nursery and high levels of seed and seedling mortality are common (but getting better) often resulting in higher priced seedlings.
- Whitebark pine habitat is commonly under snow early in the summer and may be under snow early in the fall thus the snow-free window is very narrow so workplans must be flexible.
- Recent summers have seen extreme fire hazards, which may limit the ability to access whitebark pine habitat to implement workplans.
- Access is nearly always long, difficult, and costly thus alternate worksites should be identified in the event of road closures or other events limiting access.

Despite the above issues, progress has been made on restoring whitebark pine in the region and the 2017 shortfalls will be implemented in 2018 along with additional work (Table 2). Funding to supplement that provided by the Fish and Wildlife Compensation Program has already been secured from the Forest Enhancement Society (FES) and American Forests.

Table 2. Summary of work conducted since 2016 and into future years.

Activity	2013	2014	2015	2016	2017	2018 Work Plan	2019 Work Plan	Future Plans
Cone Collections	Cones collected from 10 trees at Poison Mountain.	Cones collected from 46 putatively resistant trees.		Cones collected from 53 putatively resistant trees at 6 sites.	No cones collected in 2018.	Cones to be collected from putatively resistant trees, funded by Forest Enhancement Society.	Collect cones from putatively resistant trees if large crop is present.	Cone collections from putatively resistant trees as needed.
Seedling Production	Seedling produced from previous collections funded by Environment Canada			Review by nursery consultant to improve practices. Enough seed in production to produce 7,000 seedlings in 2017 (large die-back greatly reduced this number). Seed sent to	Approximately 5,600 seedlings produced (1,400 at Skimikin and 4,200 at Splitrock). 2,000 seedlings sold to Xeni Gwet'in First Nation.	Continue production of all seed collected in 2016 to support a large planting program in 2019.	Continue with seedling production; may be divided into multi-year deployments depending on number of seeds collected in 2018.	Continue with seedling production; may be divided into multi-year deployments depending on number of seeds collected in 2018.

Activity	2013	2014	2015	2016	2017	2018 Work Plan	2019 Work Plan	Future Plans
				Skimikin Nursery for production to buffer against any die-back. Seeds from three sites were entered into production for planting in 2018.				
Seedling Planting	500 seedlings planted over 1.5 ha at Yalakom Provincial Park.			2,250 Seedlings planted over 7.5 ha.	2,1000 seedlings planted in St'at'imc Territory (1,400 from Skimikin and 700 from Splitrock).	Minimum of 1,500 seedlings to be planted in 2018, with an additional 600 in rust screening plots. Skimikin Nursery may have an additional 2,000+	Large planting depending on nursery production levels. Target of 10,000. Continued planting is not limited by the availability of habitat. Large-scale fires created thousands of	Continue planting. Continued planting is not limited by the availability of habitat. Large-scale fires created thousands of hectares of suitable restoration habitat, which

Activity	2013	2014	2015	2016	2017	2018 Work Plan	2019 Work Plan	Future Plans
						seedlings for this location. Monitor previous plantings. Confirmed funding co-funded by American Forests and Forest Enhancement Society.	hectares of suitable restoration habitat, which could only be fully restored over decades.	could only be fully restored over decades.
White Pine Blister Rust Screening				High rust and mortality site for field-based screening identified at Blustry.	Trial not established due to high fire hazard in late summer, seedlings are being held in nursery for planting in 2018.	Planting trial to be planted at Blustry. Confirmed funding co-funded by American Forests and Forest Enhancement Society.	Monitor seedlings for survival to ensure when rust is the cause of mortality	Monitor seedlings for survival to ensure when rust is the cause of mortality
Competition Removal				Competition removal site	Competition removal not	Work to be completed by	Expansion of competition	Expansion of competition

Activity	2013	2014	2015	2016	2017	2018 Work Plan	2019 Work Plan	Future Plans
				identified at Blustry.	completed due to smoke and fire hazard; to be completed in 2018.	Xaxli'p Community Forest Crews, work is in-kind to support crew training.	removal program will depend on success of 2018 implementation.	removal program will depend on success of 2018 implementation.
Outreach	Planting at Yalakom Provincial Park implemented as an outreach event.		Outreach events conducted at Splitrock Environmental including classroom session followed by field visit. Display put up at Salmon in the Canyon Festival.	An information meeting was held to teach the public about the plight of whitebark pine. The following day a volunteer-based planting day was conducted.	A small amount of field-based outreach was conducted by direct invitation to locals not previously involved. Limits were placed due to helicopter capacity.	Expand outreach to include combined talks with other biologists, nursery tours, remote communities, and open invitations to assist with restoration work.	Expand outreach to include combined talks with other biologists, nursery tours, remote communities, and open invitations to assist with restoration work.	Expand outreach to include combined talks with other biologists, nursery tours, remote communities, and open invitations to assist with restoration work.
Health Monitoring	Management planning document		Thirteen health monitoring	Health monitoring plots		Health monitoring plots	Re-measure health plots to identify trends.	Establish new health plots as cones

Activity	2013	2014	2015	2016	2017	2018 Work Plan	2019 Work Plan	Future Plans
	created to address health of whitebark pine in region.		plots established.	established where new cone collections are conducted to identify stand health and observe trends.		established where new cone collections are conducted to identify stand health and observe trends.		collections expand to new areas and re-measure existing plots every 5-years.

5. Recommendations

The following recommendations are suggested based on work completed in 2017:

- Conduct sustained planting to ensure certainty for nursery producers and encourage a broader market for seedlings to provide a good business case for continued production;
- Continue with outreach-based restoration;
- Focus restoration efforts at sites with high levels of whitebark pine decline;
- Seek multi-year funding to limit funding caused shortfall in project implementation;
- Where conditions permit and is appropriate, implement field work as early in the season as possible to limit fire condition restrictions, which are most likely to occur later in the season;
- Identify ways to expand outreach, these may include: dove-tailing presentations with local bear biologists, visits to the local nursery, dedicated visits to more remote communities, and extending invitations to more field work.

6. References

Alberta Whitebark and Limber Pine Recovery Team. 2014. Alberta Whitebark Pine Recovery Plan 2013-2018. Alberta Environment and Sustainable Resource Development, Alberta Species at Risk Recovery Plan No. 34. Edmonton, AB. 63pp.

BC Conservation Data Centre (BCDC). (2002). Species Ranking in British Columbia. Bitish Columbia Ministry of Sustainable Resource Management. Victoria, BC. (ISBN: 0-7726-7706-9)

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2010. Assessment and Status Report on the Whitebark Pine *Pinus albicaulis* in Canada. Ottawa, ON. 44pp.

Parish, R. 1948. Tree Book: Learning to Recognize Trees of British Columbia. Partnership Agreement on Forest Resource Development. Victoria, BC. 183pp.

Pigott, D. 2012. Whitebark Pine in British Columbia. Forest Genetics Council of BC. Retrieved from http://www.fgcouncil.bc.ca/Factsheet1-WhiteBarkPine_2011.pdf