Issue No. 26: Spring/Summer 2014

Whitebark Pine Ecosystem Foundation

Nutcracker Notes

"Grizzlies among Whitebark Pine, Chilcotin Mts., B.C., photo by Sam Zirnhelt, see McCrory article"

Whitebark Pine cones from 2013 crop, see Haeussler & Clason article

Whitebark Pine Ecosystem Foundation
Nutcracker Notes, Issue No. 26; Spring / Summer 2014

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Articles

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Our Mission: The Whitebark Pine Ecosystem Foundation (WPEF) is a science-based nonprofit organization dedicated to counteracting the decline of whitebark pine and enhancing knowledge of its ecosystems.

Membership Information and an application is found at <www.whitebarkfound.org>

WPEF
P.O. Box 17943
Missoula, MT 59808

Director's Message
Diana F. Tomback

Whitebark Pine Forever 2015
We Need Your Help

The time has come for us to put our money where our mouth is. I mean this literally.

All of us who are members of the Whitebark Pine Ecosystem Foundation (WPEF) have joined out of passionate concern for the future of whitebark pine. A few have been members since 2001, when the organization first started. Many of us have attended the workshops and meetings, read proceedings and journal papers (and have published papers), or read the media accounts. We know the scale and speed of the decline of whitebark pine, especially in regions including the Rocky Mountains, Pacific Northwest, and southwestern Canada.

Restoration of whitebark pine communities is the only course of action that will enable this keystone species to survive population losses and genetic bottlenecks.

I think we all recognize the importance of restoration projects. The problem is they cost money. Restoration of whitebark pine is not a "one-off": it is not a handful of seedling planting projects or thinning projects, and thanks—we are done, mission accomplished. It's complicated and time-consuming, and we will be at this for decades.

Liz Davy, WPEF Development Committee Chair and member of the Board of Directors, is spearheading our first major campaign to raise money for whitebark pine restoration projects. Welcome to **Whitebark Pine Forever 2015.** This issue of *Nutcracker Notes* represents the official kick-off of this campaign.

This is not a casual "oh, by the way please donate." We are determined to make this work. Our goal is to raise $100,000 by June 2015—ambitious for us. We will be asking you for donations, referrals to friends, your time and help, and ideas. We want to widen the circle of whitebark pine supporters beyond that of our "in group" of people directly or indirectly involved with whitebark pine for their work—we want to reach out to everyone who loves to camp, hike, or ski surrounded by whitebark pine, or even just the idea of whitebark pine. This is the time to help.

Recently, the most dependable source of funding for whitebark pine restoration has been the U.S. Forest Service, through various programs in the National Forest System and Forest Health Protection, and especially through the Whitebark Pine Restoration Program. But, the Forest Service budget is declining, and funding for whitebark pine projects has been halved. It is now our turn. How much do we care? A lot, and we need you to work with us as a team to fund-raise to provide matching funds for restoration, and especially for the Whitebark Pine Restoration Program. Our Canadian colleagues at the same time will fund-raise to support restoration efforts and related projects underway in B.C. and Alberta.

So, you will be hearing from us through snail mail, email, on Facebook, and various other ways. Remember, this is not just a good cause, but it really is a matter of life or death for whitebark pine.

Auction Items Needed: 2014 Science and Management Workshop

We are very pleased to announce that the next annual WPEF Science and Management Workshop will be held in Coeur d'Alene, Idaho, September 19 and 20 (Friday and Saturday). The field trips include a visit to the USFS Coeur d'Alene Nursery, which pioneered the blister rust screening process for whitebark pine, as well as protocols for growing whitebark pine seedlings. Our thanks to the local organizers, Paul Zambino, John Schwandt, Sandra Kegley, and Mary Mahalovich, and a number of others, for their work in putting together the meeting.

In Coeur d'Alene, the WPEF will continue the recent tradition of hosting a social with cash bar and hors d'oeuvres following the Science and Management Workshop. At this time, attendees may bid on a number of offerings during our Silent Auction. This Silent Auction will benefit our whitebark pine student research fund. We are always looking for donations for auction of interesting crafts, goodies, and art. Laura DeNitto has graciously agreed to oversee the Silent Auction again this year. ■

Director's Message: WPEF Canada
Randy Moody

I always find it difficult to write the spring director's report after a long winter; as most of the recent months have been spent writing reports and proposals summarizing field work that was largely captured at the fall meeting in Bozeman. However, we succeeded in encouraging a lot of Canadians to write up their projects for this issue of *Nutcracker Notes*. In Canada there are still several hot items regarding whitebark pine and the Foundation, namely: health updates, board of directors, and targeted outreach.

In 2014 Parks Canada in conjunction with Alberta Environment and Sustainable Resource Development intend to re-measure all previously established health monitoring transects for whitebark and limber pine. This effort will result in a total of 282 transects re-measured to provide an up to date view of health trends in these species. The transects are located along the Rocky Mountains in B.C. and Alberta with some plots extending west to Mount Revelstoke and Glacier National Parks in B.C. Based on the not so optimistic trends reported in a recent paper produced by Cyndi Smith and others, we are waiting with baited breath to see how these latest trends compare.

As mentioned in previous reports, the Canadian Board of Directors will actively be seeking new blood in the near future so watch for a notice on board positions up for election. If you are interested in running for a board position or just being a more active member of the Canadian Foundation, please get in touch with a current board member so we can keep you abreast of developments on this matter. Speaking of board members, Judy Millar recently retired from B.C. Parks and is now leading a life of leisure from her B&B home base in Penticton.

With respect to targeted outreach, I will be making a presentation regarding the conservation concerns of whitebark pine at the Backcountry Lodges of B.C. Annual General Meeting this year. Although this group has minimal impact compared to other industries, several members of this association have identified that they can contribute to whitebark pine conservation and restoration in a number of capacities; thus I was approached to engage their membership to identify commonalities between our groups' objectives. Although most of these lodges are winter based, some operate year-round, and all have some periodic presence over the summer months; thus I intend to present a range of conservation activities they may participate in including visitor outreach, cone collections, and monitoring. Hopefully in the fall report I will be able to comment on activities being voluntarily conducted by several backcountry lodges in B.C. ■

SAVE THE DATE

Annual Conference set for Coeur d'Alene

September 19-20, 2014

WPEF's Annual Science and Management Workshop is scheduled for Friday and Saturday, September 19-20, 2014 at the Idaho Panhandle National Forests Supervisors Office in Coeur d'Alene, ID. The workshop's theme, "15 Years of Whitebark Pine Restoration", will be addressed by scientists and practitioners working on improving whitebark pine blister rust resistance and restoration planting through presentations and field trips.

Topics proposed for the workshop, pending speaker confirmation, include:

15 years of WBP tree improvement
Whitebark pine research and management efforts on the Idaho Panhandle National Forests
Climate change considerations
Latest nutcracker information
Rodent impacts on seed predation and caching
Latest nursery developments in germinating seed, growing seedlings, and screening for rust resistance
What are we learning about daylighting in whitebark pine?
Regeneration guidelines
Direct seeding as a restoration tool
Is natural regeneration working in the Selkirk Mountains of Northern Idaho?
How well is whitebark pine re-establishing after fires?
Mountain Pine Beetle Impacts on whitebark pine in Central Idaho and Montana
Other important issues and projects

If you have an interesting project or results please contact Mary Frances Mahalovich (mmahalovich@fs.fed.us), program coordinator, to bring a poster for display.

On Thursday evening (September 18), there will be a public meeting for the local community to describe the plight of whitebark pine and restoration efforts.

On Friday afternoon there will be a field trip to visit the USFS nursery in Coeur d'Alene to tour the seed extractor, view grafted seed orchard material, the rust inoculation process, and examine seedlings from previous inoculations for rust symptoms. If you have ever wondered what happens to the cones you are collecting or how rust inoculation tests are conducted you won't want to miss this trip. The USFS Nursery is located on the northwest edge of Coeur d'Alene less than a mile from the meeting location.

On Friday evening, the WPEF will be hosting a reception and silent auction, so be sure to bring auction items.

An additional field trip on Saturday to Gold Pass on the ID-MT divide near St. Regis, MT will provide an opportunity to see operational daylighting and planting as well as outcomes from two direct seeding trials.

Society of American Foresters continuing education credits will be available.

The workshop venue will be the USFS Idaho Panhandle National Forests Supervisor's Office in Coeur d'Alene (3815 Schreiber Way off Kathleen Ave between highway 95 and Ramsey Road). A small block of rooms has been reserved for $85 as the "*Whitebark Pine Meeting*" at the Holiday Inn Express (208-667-3100, www.hiexpress.com/coeurdalene) at the west edge of town (exit #11 from I-90). Since rooms are limited and reservations are on a first-come, first-served basis, reservations should be made as soon as possible. . Please contact John Schwandt (jwschwandt@gmail.com) if you have questions about local arrangements.

Coeur d'Alene is located on the northern shore of Lake Coeur d'Alene and is a center of business and recreational activity in the Inland Northwest, complete with festivals, fairs, concerts, unique bistros, and elegant restaurants. The newly improved central park downtown is a treat for people of all ages. It is at the base of Tubbs Hill--a 120 acre natural park and forest that juts out into the Lake and provides spectacular views of sunsets and surrounding rolling countryside. Coeur d'Alene has an educational corridor that includes branch campuses of University of Idaho, Boise State University, and Lewis & Clark State College as well as North Idaho Junior College. Coeur d'Alene is a bike-friendly town with outstanding trails winding through town and along Lake Coeur d'Alene and the Spokane River. Just out of town is the Trail of the Coeur d'Alenes, a 73 mile paved bike trail that runs from the mountains 30 miles east of town along the Coeur d'Alene River to the southern end of Lake Coeur d'Alene and has numerous trail heads and picnic areas. For the more adventuresome, the nationally acclaimed Hiawatha Trail near Lookout Pass on the Idaho/Montana border provides a one-of-a-kind recreational experience. This gravel bike trail winds through 9 tunnels and over 7 trestles in 14 miles of the old railroad grade over the pass (flashlights, helmets, and a $10 pass are required).

More details and registration information will be posted on the WPEF's website (www.whitebarkfound.org) as it becomes available. ■

"Pint Night" funds Whitebark Restoration

Edie Dooley and Bob Keane

On April 23rd, the Whitebark Pine Ecosystem Foundation hosted its first ever Pint Night in Missoula, Montana. The event was graciously hosted by the Northside Kettlehouse as part of its weekly Community Unite series. This Kettlehouse hosts one nonprofit weekly and 50 cents of every pint sold is donated to the featured nonprofit. Between 5 and 8 pm, 280 pints were sold, for a total donation of $140 from the Kettlehouse to the Whitebark Pine Ecosystem Foundation. Additionally, WPEF sold merchandise, and held a raffle of WPEF merchandise, two Good Food Store Gift Cards, and a $50.00 gift card to REI, and raised over $150 from sales of tickets and merchandise.

While the pint night was a financial success, its true value was that it provided an opportunity for WPEF to gain exposure in the community of Missoula and to make new friends. WPEF signed up two new members at the event. Several casual beer drinkers visited WPEF's table to ask "so what's the deal with whitebark pine?" Those already familiar with the importance and status of whitebark pine were able to converse about their love of the tree, as well as make valuable professional connections to others working on whitebark pines.

Whitebark pine enthusiast, Melissa Early said, "As a wilderness ranger and recreational hugger of whitebarks, I now am more motivated to become a member of WPEF, and to speak about some of the wonders of whitebark pine in my presentations as wilderness ranger at trailheads in celebration of the 50th anniversary of the Wilderness Act. I will be stationed at Jackson, WY, and I am interested in volunteering for the foundation in that area."

The event was very well attended, with at least 100 people drinking beer at one time! Overall, the Unite was easy to organize; the hardest part was publicizing the event. We hope that other WPEF members will follow the lead and host a pint night in their local part of whitebark pine's vast range. As WPEF grows in its reach with an invigorated fund-raising campaign, and the new ski area initiatives, establishing a public face in communities and providing fun, casual opportunities for whitebark pine enthusiasts to connect about the tree they love will become increasingly important.

Thank you to our sponsors, the Northside Kettlehouse, the Good Food Store and Missoula REI! And thanks to all who attended and made the event fun and successful. We plan to do it again next year, and hope to see you there! ■

"Whitebark Forever 2015" Restoration Campaign

The Whitebark Pine Ecosystem Foundation is teaming up with the Forest Service, BLM, Park Service and western ski areas to restore whitebark pine. Each year, the Forest Service funds $100,000 of whitebark pine restoration and research projects. In a campaign beginning this year, the Whitebark Pine Ecosystem Foundation plans to match those funds to increase restoration capacity in the western States.

How can you help? Donate now to fund restoration projects such as

- ✓ **Plant** whitebark pine seedlings
- ✓ **Collect** whitebark pine cones for future seedlings
- ✓ **Grow** blister rust resistant trees in whitebark pine seed orchards
- ✓ **Protect** high value whitebark pine trees from bark beetle attacks
- ✓ **Remove** other trees from growing whitebark pine

Our goal is to raise **$100,000 by June 2015** to match the funds provided by the Forest Service. Be a part of keeping whitebark pine, a keystone species of the high mountain landscape.

Please visit our web site (www.whitebarkfound.org) and click on **RESTORATION** to donate or mail your donation to WPEF, P.O. Box 17943, Missoula, MT 59808. Your money will be matched by funds from the Forest Service providing much needed restoration to our whitebark pine landscape.

Thanks for your support,

Liz Davy, Development Committee Chair

Call for Proposals: 2014 Student Research Grant

The mission of the Whitebark Pine Ecosystem Foundation (WPEF) is to "promote the conservation of whitebark pine and other high elevation five needle white pine ecosystems through education, restoration, management, and research." In support of this mission, the WPEF will be offering a research grant of $1000 to an undergraduate who is writing an undergraduate thesis or graduate student (MS or PhD) conducting research on whitebark pine. Relevant areas of research include, but are not limited to: threats to whitebark pine, including mountain pine beetle, white pine blister rust, successional replacement, and climate change (only in whitebark ecosystems); interactions with wildlife, such as Clark's nutcracker or other birds, red squirrels and grizzly bears; restoration strategies for whitebark pine, including both field operations and nursery seedling production; and

ecosystem level impacts of whitebark pine die off.

Monies will only be awarded for travel expenses for field work, or consumable research supplies. Grants shall not be used to buy equipment that will be used beyond the duration of the project (and thus would be retained by the lab in which the student works).

Please submit a short (two single-spaced pages at most, not including references) proposal covering:

1. The purpose and need for the research
2. A brief description of the study plan and methods, including expected dates of data collection and writing completion
3. Expected outcomes of the research
4. A brief explanation of how the money will be spent
5. Contact information and academic affiliation of the student

Grant recipients are encouraged to present the findings of their research at the 2014 WPEF annual meeting and are expected to publish a summary of the research in Nutcracker Notes. In addition to the proposal, applications should include a CV as well as a letter of recommendation from the student's research advisor. All applicants are encouraged to join WPEF and the grant recipient will receive a free subscription to Nutcracker Notes for one year.

Please send application materials (electronic only) to <Cyndi.smith9@gmail.com> by August 31, 2014. ■

Election News

Cyndi Smith, WPEF Associate Director

The Foundation recently held board elections. We had 100 ballots returned from a possible 150 eligible members, for a 67% participation rate. One ballot was mailed in, but was blank, and did not count. This is the highest participation rate we've had since 2010.

We received one comment regarding why we send out a ballot when there is only one candidate running for each vacant position, in effect only asking the membership to ratify acclamations. This is in the bylaws (E.f.1) so that the Board of Directors (BOD) is held accountable to the membership to run an election. The Nominating Committee tries hard to get multiple candidates for each position, but this is often difficult … as most of you know who are involved with small organizations!

I was re-elected as Associate Director, and this will be my final term in this position, as the bylaws (F.a.2) only allow three 3-year terms in any given position. Vick Applegate was re-elected as Treasurer. We also welcome back general board members Edie Dooley and Liz Davy. Terms start after the September annual general meeting, except for Liz, who is filling a BOD vacancy and her position is effective immediately.

The BOD is also facing the fact that Diana Tomback, who was a founding member of the Foundation and its Director since inception, is serving her final term and must step down in the fall of 2016. While no person is irreplaceable, Diana's passion, commitment, connections and savvy have set the Foundation on a solid footing. One difficulty in finding a new Director is that it's a very public position, and the Director often has to make media statements about whitebark pine … this virtually precludes a federal government employee from filling this vital position. We welcome your suggestions for nominees.

We have one board-appointed vacancy, for a single 3-year term, for a general board member. We are searching for a dynamic individual who is willing to step up and be active in the Foundation … please forward any suggestions to me at cyndi.smith9@gmail.com. We want to fill this position before the September board meeting. These passionate, environmentally-minded people do not need to be working in the resource management field, as we need all kinds of expertise on the Board. ■

Interview with Vick Applegate

Editor: When and where did you first become acquainted with whitebark pine? What impressed you about this tree?

Applegate: In the mid-1960s while working on a trail crew and hiking in the Cabinet Wilderness Area in northwestern Montana . . . I was impressed by WPB's ability to grow in the high elevation harsh environment with poor rocky soils and at times clinging to 'goat rocks'. I also love the alpine environment where they grow and the animals they help support.

Years later, while working in the Big Belt Mountains of central Montana, I was impressed with whitebark and limber pine growing on limestone soils in the same area. To this day, I still cannot tell the difference between the two species without seeing the cones.

Editor: Where are the most extensive and impressive whitebark pine forests you have seen?

Applegate: Dense krummholz conditions especially when a trail tunnels through them, or I have to bush-whack my way through. Wallowing through krummholz can also leave you very pitchy. I still carry rubbing alcohol in my camper and have found that it is the best for removing pitch from me and my equipment.

I think the Beartooth Plateau trees are very impressive. At an elevation over 10,000' whitebark pine grow in large bedrock cracks, narrow gullies and mini-canyons that I can't jump across and are 5 to 20 feet deep. Here the trees can barely clear the surrounding bedrock in height and form krumholtz, yet they have diameters in excess of a couple feet. The harsh environment does not allow them to maintain tree structure much above the bedrock surface, but their stems develop pretty well in the shelter of the mini-canyons below.

Editor: As a casual birder have you made some interesting observations of Clark's Nutcrackers?

Applegate: I love how nutcrackers make their presence known. Their call is distinctive and lets me know several are moving through the area. Their call always brings back fond memories of the high country even if I'm in a low elevation forest in August where the birds are extracting ponderosa pine seeds. It's like the 'call of the alpine.'

Editor: What kind of whitebark pine restoration activities have you designed or been involved with?

Applegate: Thinning favoring whitebark pine, selection of apparently genetically resistant whitebark pine, establishing whitebark pine permanent plots, collecting whitebark pine cones and placing pheromone packets.

Editor: What kind of actions [treatments?] do you think hold the most promise for restoring significant amounts of whitebark pine despite its challenges from blister rust, bark beetles, and successional replacement?

Applegate: Prescribed burning and wildland fire in whitebark pine habitat, protection of apparently resistant trees, and genetic breeding for blister rust resistance. ■

WHITEBARK PINE ECOSYSTEM FOUNDATION

Treasurers Report - 4/30/2014

	1/1/2012	1/1/2013
BALANCE (Beginning Year - Checking and Savings)	$37,937.70	**$35,366.17**
EXPENSES		
Accountant fee (Tackett) 1/	$300.00	**$300.00**
Administrative assistant	$6,000.00	**$6,000.00**
Advertizing		**$400.00**
All Merchandise	$1,517.61	**$2,322.35**
State Registration		**$15.00**
Bank fees	$111.09	**$102.60**
Bumper Stickers	$322.25	**$0.00**
Mailing/operating expenses	$787.73	**$373.95**
Membership expenses	$207.53	**$339.81**
Nutcracker Notes	$1,785.08	**$1,731.01**
P.O. Box fee - Yearly	$86.00	**$88.00**
PayPal fees	$118.52	**$79.11**
Room rental (Annual meeting)	$532.27	**$1,089.60**
Student Research Grant	$1,000.00	**$1,000.00**
Symposium Support IUFRO		**$1,000.00**
Travel - Plane fares and lodging	$2,403.66	**$2,084.55**
WPEF Website Contractor	$500.00	**$2,070.00**
Website Contract UC Denver - USFS		**$7,886.76**
Total Expenses	$15,671.74	**$26,882.74**
INCOME		
Donation for Bumper Stickers (Tomback)	$322.25	**$0.00**
Donation State Annual Registration		**$15.00**
Donations	$551.74	**$1,450.00**
Interest Earned	$32.27	**$18.54**
Membership	$10,453.44	**$11,652.37**
Merchandise - Calendars	$228.00	**$125.00**
Merchandise Sales Other		**$1,469.00**
Symposium/Annual Mtg/Merchandise 2/	$1,512.51	**$894.00**
Website Contract UC Denver -USFS		**$13,144.60**
Total Income	$13,100.21	**$28,768.51**
BALANCE	$35,366.17	**$37,251.94**
Ending Period as of	12/31/2012	**4/30/2014**

1/ Accountant Fee, $200 is donation

2/ 2012 includes 2011 Symposium Income ■

Chasing Grizzlies in B.C. Whitebark Habitat

Wayne P. McCrory, Registered Professional Biologist,
Valhalla Wilderness Soc., New Denver, B.C.

I was high up a mountain on an abandoned mine road where the whitebark pines were thinning out and getting smaller in size when I noticed that my task of counting grizzly bear scats containing the distinctive whitebark pinenut residue suddenly got nerve-wracking. I'd counted three large scats, several sets of grizzly tracks, and lots of fresh excavations where a bear had been hunting for pine cones stashed by red squirrels. All bear sign was fairly fresh, but now I was seeing both large and small scats, signifying there was a mother grizzly and at least one young somewhere nearby. I noticed a small whitebark pine with a broken top and silvertip grizzly bear hairs embedded on the broken ends of branches – evidence of a grizzly bear "mark" or rub tree. I carefully plucked half a dozen of the longer hairs off the tree and placed them in an envelope for future DNA analysis.

The road was overgrown with trees and the visibility was increasingly poor. In spite of having a large canister of bear spray and periodically yelling "Yo, Bear!" I'd had my fair share of close encounters with *Ursus horribilis* in my 40-year field career as a bear biologist. I decided to stop at an overlook of the valley and contemplate whether to carry on to the alpine or turn back. It was a sunny, lazy mid-October day, ideal for hiking in the high country and, besides surveying grizzly bear use of the whitebark pine stands, I wanted to hike above treeline to check out the alpine meadows for grizzly bear winter dens and evidence of digging for roots.

The sweeping vista below me was breathtaking and I had it all to myself (except that momma grizzly and young were probably resting somewhere nearby!). The fading warmth of the autumn sun and the view helped relax my nerves, but I didn't drop my guard. Lower down, stands of whitebark pine mixed with lodgepole pine and spruce blanketed the Tchaikazan Valley. In the far distance, the grey-blue waters of Lower Dasiqox-Taseko Lake shimmered in the sunlight. It was a magnificent wilderness area to be studying for a First Nations tribal park, or a provincial park or conservancy.

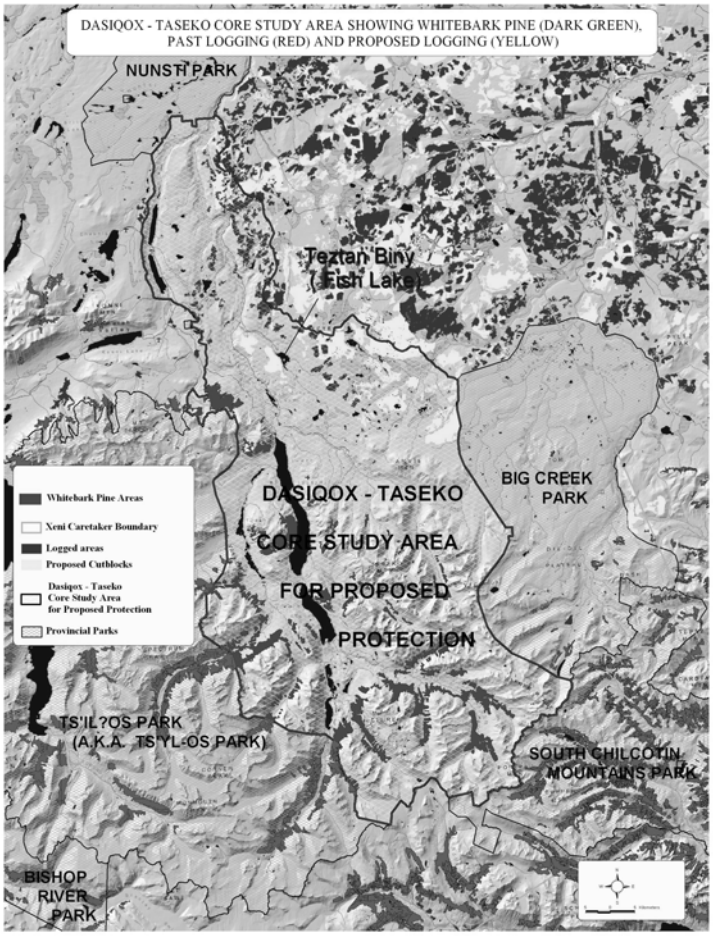
Studying grizzly bear use of whitebark pine stands was new and exciting. I had studied and mapped grizzly bear habitat in the foothills of the Canadian Rockies, where there was barely any grizzly bear use of whitebark pine nuts. I wondered why, here in BC's Chilcotin Ranges, even with some of the grizzly bears' most favoured autumn food item -- Pacific wild salmon -- still available for bears to feed on in the lower Tchaikazan River system and around the Dasiqox-Taseko Lakes, was I finding so much evidence of grizzlies feeding on pinenuts in these mid- to high-elevation whitebark stands. This was the fourth high-elevation area I had tromped around in over the past week and all had evidence of 1-3 grizzly bears feeding on pinenuts.

I was seeing confirmation of what Randy Moody, a director of the *Whitebark Pine Ecosystem Foundation*, had told me about whitebark pine in the Chilcotin likely being the most intact and functioning whitebark pine ecosystems in BC. Our own surveys had shown these pine stands to be extensive, and confirmed what Xeni Gwet'in (pronounced "honey-gwet-een") knowledge-keepers Alice and Norman Williams, had told me about their observations of late fall use of whitebark pine nuts by grizzly bears. Today, Norman and Alice had stayed behind in one of the valleys below to document an ancient pithouse (kekuli) village. One cultural depression measured 90 feet across, evidence of a large underground lodge that had housed many of their ancestors through the harsh, Chilcotin winters. Alice felt the village was located where not only could it take advantage of salmon runs, abundant big game, and a variety of berry and root foods, but also because of the availability of white bark pine nuts that they roasted in fire pits and stored as part of their traditional winter survival diet. In some way, both First Nations and grizzly bears shared similar diets, with both surviving the winter under mother earth's mantle.

This was our third field trip documenting what were obviously very high conservation and First Nations cultural/heritage values for the proposed 184,794 hectare (456,620 acre) Dasiqox-Taseko park study area. Slowly, whitebark pine was now coming into its own as a high value conservation focal species as well as a First Nations cultural keystone species.

Although stands of whitebark pine were already protected in the five surrounding provincial parks, I now saw that significant areas had been left out, especially the mixed stands at lower elevations critical to landscape genetic continuity. The Dasiqox-Taseko was also being studied because, if kept intact instead of logged, it would provide critical connectivity for grizzly bears and other wildlife between the five parks; in other words, one of its highest values was as a large connectivity landscape. Protecting the area would also protect ancient First Nations trade and hunting trails, battlegrounds, and food-gathering and other sites dating back thousands of years.

I had no doubt that the whole area was highly significant and needed to receive greater protection than currently under a 1989 aboriginal decree and a 2002 wild horse preserve decree by the Xeni Gwet'in. These decrees by the elders prohibit industrial forestry, mining, and hydroelectric development over an area



The map shows that past and proposed logging appear to be limited around whitebark pine areas, but proposed logging will impact more areas if allowed to proceed.

Xeni Gwet'in researcher Alice William at 800-year old whitebark pine tree along a mine road in Falls River.

nearly the size of Yellowstone National Park. Although these declarations meet both the IUCN definition of a protected area, as well as the international definition of an Indigenous and Community Conserved Area (ICAA) by the 2003 World Parks Congress, the BC and Canadian governments have not recognized aboriginal protection designations. Instead, governments have allowed controversial mining exploration and massive clearcut logging schemes that provide for only nominal protection of cultural/heritage values and species-at-risk, such as whitebark pine and grizzly bears.

From the perch on my rock, I noted a stand of ancient-looking whitebark pines far below me that had gnarly trunks a metre or so across; about the same size as the old whitebarks that had been aged in an adjacent valley a month earlier by Craig Pettitt, a director of the Valhalla Wilderness Society and an expert on aging old trees. The largest tree was estimated to be 800 years old.

Suddenly my autumn reverie was broken by the raucous calls of a group of Clark's nutcrackers (what we call pine crows) winging along through the treetops, followed by the louder sounds of a boulder bouncing down the mountainside across the gulley. There is only one thing large enough on this hillside today to dislodge such a large boulder. Time to go home and leave the mountain and the whitebark habitat to mama grizzly!

Postscript: Both knowledge-keepers and researchers, Alice William (Xeni Gwet'in) and Linda Smith (M.Sc., Yunesit'in), provided major contributions on the keystone cultural species, including traditional uses, and legends and stories from their ancestors. Among the many high values, the extensive and still-healthy whitebark pine stands were recognized by all as highly significant to protect, especially as massive clearcut logging and roading approaching from the north. The Xeni Gwet'in and Yunesit'in First Nations are contemplating a 184,794 hectare (456,620 acre) or larger Tribal Park, possibly named "Weneen" or "Our Land," as the first step in getting the province of BC to provide legislated protection. For more information or to support protection, Wayne McCrory can be reached at waynem@vws.org. A report of the study, *Inventory of Wildlife, Ecological, and Landscape Connectivity Values, Tsilhqot'in First Nations Cultural/Heritage Values & Resource Conflicts in the Dasiqox-Taseko Watershed, BC Chilcotin*, will be available soon. It was funded mainly by the Wilburforce Foundation with some support from the McLean Foundation, Stewart Fund, Ed Wolf, Valhalla Wilderness Society, Friends of Nemiah Valley, AFSAR, as well as the Xeni Gwet'in, Yunesit'in, and Tsilhqot'in governments. All are gratefully acknowledged for their support. ■

Nutcrackers and Whitebark Cone Production in Northwestern B.C.

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Jodie Krakowski, Bulkley Valley Research Center

Objectives

In 2011 a pilot study was done through the Bulkley Valley Research Centre in Smithers, B.C. in order to: (1) document Clark's Nutcracker use of whitebark pine communities at the northern extent of their ranges; (2) estimate population density of Clark's Nutcracker, and (3) obtain a snapshot of density relative to that required to maintain Clark's Nutcracker populations at their northern limits.

Methods

Nutcracker observations

Nutcracker surveys were done in conjunction with forest health surveys (described in another article in this issue). This pilot study followed the protocol of the Whitebark Pine Ecosystem Foundation (Tomback et al. 2005) for transect establishment and Scott's (2009) line transect distance protocol to estimate nutcracker density per stand.

Eagle Pass and Hankin Plateau were accessed by hiking. Kidprice Lake was accessible by plane and backcountry canoe travel (Figure 1). Transect orientation and length was adjusted to fit within each stand. Transects were used for nutcracker surveys, forest health plots and cone counting. Data collected for each binocular observation included: activity, tree species associated with activity, presence/absence of cones, and tree health. For non-visible vocalizations observers estimated distance and direction.

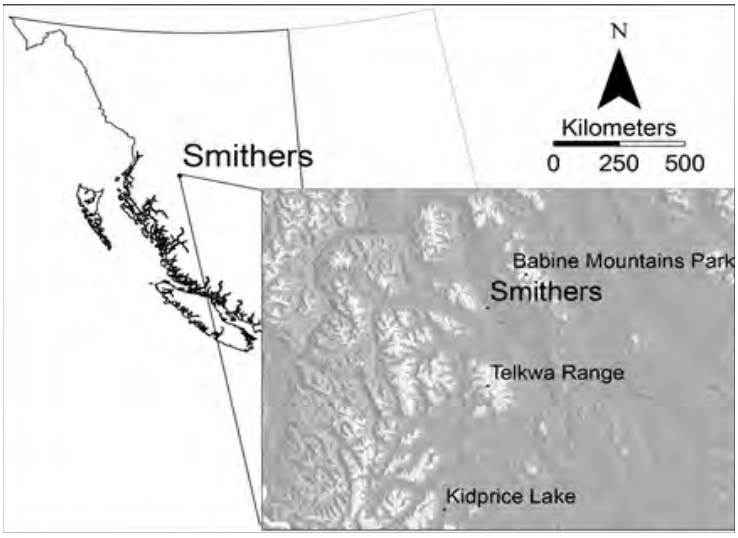

Figure 1: Study Area and Transect Locations in British Columbia, Canada. Eagle Pass transect is located in Babine Mountains Provincial Park. Hankin Plateau transect is located in the Telkwa Mountain Range.

Site & Transect	Transect		Tag number		Date		
	Length (m)	Elev.	Start	End	Nutcracker surveys	Forest health	Cone counts
Kidprice Lake	500	1033	990	no tag	26 July 2011;	26 July 2011; 14 Oct 2011	26 July 2011
Eagle Pass a	200	1532	975	977	4 Aug 2011; 27 Aug 2011	27 Aug 2011	27 Aug 2011
Eagle Pass b	300	1567	974	976			
Hankin Plateau	750	1483	977	978	26 Aug 2011	26 Aug 2011	26 Aug 2011

Table 1: Transect Summary Information

Cone estimates

The same two observers walked 10 m on either side of each line transect, counting cones with binoculars. Trees were classed by DBH: small, <15 cm; medium, 15-30 cm; large, >30 cm.

Results & Discussion

Nutcracker observations

There were too few observations during this pilot study to calculate density of Clark's Nutcracker in the study area. Resident birds were seen repeatedly at Hankin and Kidprice feeding from caches, from ripening cones, and insects from the ground and low aerial flights. At Hankin, pairs were seen in July and August, including both adults feeding one large fledging from caches. At Kidprice Lake, pairs were seen in July. One bird appeared to cache seeds in the nearby 2004 Nanika wildfire, where whitebark pine germinants were observed during 2010. At Eagle Pass, nutcrackers were seen in July and early August. No pair behaviour or fledgings were noted. In late August, a flock of ~15 and another of ~25 nutcrackers indicated the start of migration. A nearby restoration study in the 2010 Gosnell burn observed parents feeding fledglings on June 27 2011.

Regional information was summarized from the British Columbia Breeding Bird Atlas (Fig. 2). The Smithers area and the Takla Range in north central B.C. comprise the northern extent of the known breeding range of the Clark's Nutcracker (Figure 2). These observations coincide with the range limits of whitebark pine. The northwestern observations are from this study and local naturalists groups. The northeastern observations recorded during a helicopter flight in September 2007 over the Takla Range (Courtesy of Joanne Vinnedge, Ministry of Forest, Lands and Natural Resource Operations, British Columbia Government).

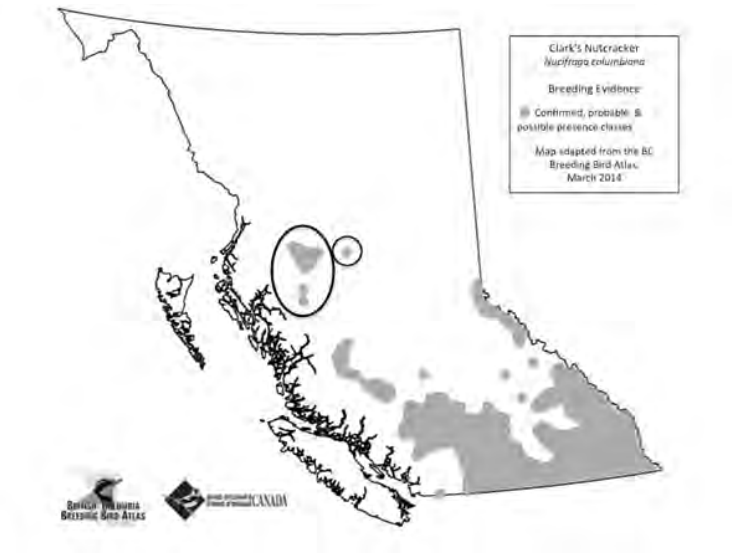

Figure 2: Clark's Nutcracker information from the Breeding Bird Atlas of B.C. (northwestern circle: Smithers area; northeastern circle: Mount Sidney Williams, Fort St. James area).

Conducting 4-5 bird surveys per season would be possible for Eagle Pass and Hankin Plateau to supplement this study and pool data with observations from other projects in the region. For the remote Kidprice Lake site, bird surveys will have to continue to be associated with cone caging and collecting trips. A third, more accessible, transect should be established at a lower elevation site for comparison with Kidprice Lake. Maintaining yearly bird counts at these 3 transects using these methods would require 15 days per year (5 visits per site x 3 sites @ 1 day per site).

Cone estimates

Cone survey transect area was calculated by estimating the width where cones could reliably be counted from the transect line times the length (Table 2). The reliable counting distance was correlated between observers in the field and varied with topography and crown closure.

Transect	Width (m)	Length (m)	Area (ha)
Kidprice Lake	40	500	2.0
Eagle Pass (a)	n/a	n/a	n/a
Eagle Pass (b)	30	600	3.6
Hankin Plateau	40	200	0.8

Table 2: Reliable transect area for cone counting surveys.

Hankin Plateau suffered heavily from white pine blister rust: most trees had no cones, and a third of the trees were dead. Between July and August, the main nutcracker fledgling period, the number of cones decreased by 37%. At Eagle Pass, all but one tree had cones. This site had the highest cone density, 775 cones/ha (Table 3). At Kidprice Lake, most cones were found on medium or small trees. In this relatively low to moderate cone production year, all sites were below the threshold estimated to maintain local nutcracker populations and sustain whitebark pine ecosystems, but within the whitebark pine basal area capable of supporting nutcracker visits (Barringer et al. 2012; McKinney et al. 2009; Lorenz et al. 2011). Whitebark pine basal area and cone density at Hankin Plateau is likely to drop below that capable of attracting nutcrackers as stand health declines, without restoration intervention.

Transect	Date (2011)	DBH class	Total trees	Cones/ DBH class	Total cones	Cones/ tree	Trees lacking cones	Transect area (ha)	Cone density (cones/ ha)
Kidprice	27-July	S	107	119	425	1	108	2.0	213
		M	86	266		3			
		L	9	40		4			
Eagle Pass (b)	27-Aug	S	6	20	620	3	1	0.8	775
		M	40	453		11			
		L	4	147		37			
Hankin	2-Aug	S	10	31	49	3	368	1.8	27
		M	6	18		3			
		L	0	0		0			
Hankin	26-Aug	S	15	30	31	2	not recounted	1.8	17
		M	1	1		1			
		L	0	0		0			

Table 3: Cone densities by diameter class.

Critically, cone numbers did not reflect the number or quality of the seeds inside the cones, which were subsequently found to be of much higher quality at Kidprice Lake (1033 m) than at Eagle Pass (~1550 m). No cones were collected at Hankin Plateau in 2011 due to the very low cone numbers and poor stand health.

Seeds collected were stratified, clipped, and then germinated and grown in a commercial nursery. A subset of the seeds was x-rayed. Seed quality in each stand differed, although they were from the same region. The seeds from Eagle Pass and Jonas Creek were smaller with poorly developed embryos. Over 75% of seedlings in the nursery now are from the Kidprice Lake site, which had the best quality seed. Seed from Eagle Pass had almost no germination since most seed was not fertilized.

This finding has implications not only for Clark's Nutcracker feeding, fledging and seed caching behaviours, but also for seed collection and restoration efforts. The nutritious seed tissue still attracts nutcrackers to whitebark pine habitat, even if seed viability is low; however, very undeveloped seed cones are extremely hard to open and are not likely to attract birds.

Dense cone crops, such as occurred at Eagle Pass in 2011, are not necessarily prime locations for cone collection efforts for restoration. Ideally, collections would occur during mast years to maximize success in seed quality and quantity.

Conclusions

Based on the current status of the whitebark pine stands in the area, the focus for whitebark pine should be on restoration efforts that include: cone and seed collection; seed stratification; germination, replanting and removal of competing vegetation. Because whitebark pine relies on Clark's Nutcracker for dispersal, continued monitoring of nutcracker numbers would provide valuable information on long-term population viability to supplement data from this pilot study.

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Rust Resistance Screening Progress in B.C.

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British Columbia is larger than California, Oregon, and Washington combined. This presents unlimited challenges and opportunities for whitebark pine conservation in an immense frontier. Rather than being overwhelmed, a cadre of dedicated specialists are busy making a difference. The development of seedlings able to survive white pine blister rust is crucial for sustaining this species. Fortunately, the quest for identifying disease-resistant whitebark pine trees in BC has been bolstered recently. There are at least three tandem efforts occurring in BC: genomics testing, field screening, and controlled inoculations.

The genomics research is being conducted by Jun-Jun Liu (Canadian Forest Service) and Richard Hamelin (Univ. of BC) who are investigating transferability of western white pine genetic markers into whitebark pine. So far, we have verified more than 200 western white pine markers. Dr. Liu believes that at least 50% of them would work in whitebark pine. In addition, we hope to verify some of species-specific in-silico whitebark markers in the whitebark pine populations. We have extracted genomic DNA from 11 Kootenay BC seedlots and some OR and WA seedlots. The next step is to figure out how many markers and how many seedlings will be put into SNP genotyping. Hopefully, we can get some insight into whitebark pine genetic diversity first this year and resistance association later in coming years.

The first-ever controlled inoculations of whitebark pine families in BC took place last August at the Kalamalka Forestry Centre in Vernon (see *Nutcracker Notes* issue no. 25). This effort has focused on 40 families from the Kootenay region with results (i.e. identification of disease-resistant families) expected over the next five years. Meanwhile, demand continues for further screening for other regions in BC. Thankfully, new funding from the BC Forest Genetics Council will permit work to continue. In February, the USFS Coeur d'Alene Nursery provided us with cuttings of *Ribes nigrum* (blackdown variety) to enhance our capabilities. Our plan is to inoculate 40 additional families per year for the next three years. Seedlings will be collected by multiple jurisdications such as national and provincial parks and possibly mining companies who have expressed an interest in using whitebark pine to rehabilitate their high-elevation impacts (see see *Nutcracker Notes* issue no. 23). The coordinators for controlled inoculations are Michael Murray and Ward Strong (Ministry of Forests).

Our field screening project is a comprehensive parent tree testing and rust resistance screening effort. The goal is to test 500 parent trees collected from 50 populations from throughout the range of whitebark pine in BC and the United States. Eight long-term field trials will be established to assess family level resistance to white pine blister rust. The deliverable for this project will be the identification of parent trees with high levels of resistance which can be used for restoration efforts. Charlie Cartwright (Ministry of Forests) is the lead coordinator.

All our work has benefited through the close collaboration with our friends in the US Forest Service who have shared technical knowledge, *Ribes*, and whitebark pine families (for comparing results): Dorena Genetic Resource Center, OR, Institute of Forest Genetics, Placerville, CA, and Coeur d'Alene Nursery, ID. Our efforts are on-going. No operational funding (e.g. base funding) has been readily available. However, these multi-year projects are expected to continue with a steady stream of soft funds already earmarked through 2019 or longer. ■

Whitebark Restoration Advances in Northern B.C.

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In northern British Columbia, the first cohort of 760 locally-grown whitebark seedlings from putatively blister rust-resistant parent trees located in the region are scheduled for outplanting after snowmelt in June 2014 (Figure 1). This will be a huge milestone for the whitebark pine restoration program of the Bulkley Valley Research Centre (BVRC), a nonprofit located in Smithers, B.C., at the northern limit of whitebark pine.

Figure 1. Whitebark pine seedlings grown at Woodmere Nursery, Telkwa, BC are ready for outplanting in Nanika-Kidprice/Nenikekh Provincial Park in June 2014.

Following baseline research reported in Nutcracker Notes (Haeussler 2008, Clason et al. 2009), the BVRC's whitebark pine restoration program began in earnest in 2011 (Haeussler 2010; www.bvcentre.ca/whitebark) and gained significant momentum when whitebark pine was listed as endangered under Canada's Species At Risk Act in 2012. Two mining companies, two northern BC community forests, BC Timber Sales -a provincial government organization that markets Crown timber- and BC Parks have now partnered with the BVRC to include whitebark pine in their planting and habitat restoration programs. We are optimistic that major forest corporations operating in whitebark pine habitat will soon follow suit.

The 2013 whitebark pine seed crop was much better than expected in west central BC. With a heroic effort from tree climber John Kelson, we installed 621 cages on 91 putatively rust-resistant parent trees spread across 9 locations, collecting 2466 cones (Fig. 2, bottom of front cover) and extracting some 227,000 seeds. This was a major increase over our 2011 collection of 30,000 seeds and could not have taken place without contributions from over 20 organizations.

Seeds from this 2013 collection will contribute to: (1) ex-situ conservation of whitebark pine genotypes by the BC Forest Genetics council; (2) a BC-wide rust-resistance screening field trial (following up on Murray 2013); (3) rehabilitation trials at the Huckleberry Mine and proposed Blackwater Mine (Moody and Clason 2013); (4) restoration of the Nanika, Atna (both in BC Provincial Parks) and Gosnell wildfires; (5) mountain pine beetle restoration efforts in the Wetz-in'Kwa Community Forest and BC Timber Sales Babine business area; (6) outreach and education activities throughout the region. The lands in (4) and (5) lie within traditional territories of the Wet'suwet'en Nation who have been a partner in our whitebark pine work since 2007 and have contributed significantly to whitebark pine outreach and education efforts in the region (Fig. 3).

Figure 3. David Dewit, Natural Resources Manager for the Office of the Wet'suwet'en, shows off a new interpretive sign featuring whitebark pine to BC Community Forest Association members at a traditional Wet'suwet'en gathering place in the Wetzin'Kwa Community Forest. Photo credit: Susan Mulkey, BCCFA.

To date, the BVRC and University of Northern BC have jointly established 3 whitebark pine restoration trials at 6 sites located across northern BC using 636 seedlings grown by UNBC researchers Linda Tackaberry and Hugues Massicotte from southern BC and Washington provenances. Seedling performance to date has been excellent (97% survival overall), except that at our lower subalpine (1000 m elev.) Wetzin'Kwa Community Forest site, seedlings recovered from mild summer heat damage in 2012 only to experience heavy browsing by snowshoe hares in the fall of 2013. The upper subalpine (1300 m) and timberline (1600 m) sites in this assisted migration trial did not experience similar damage. No blister rust has yet been observed after 1 to 3 growing seasons in the field, although *Ribes* are abundant at 2 of 6 sites.

With the first locally-grown seedlings scheduled for planting in 2014 and some 160,000 seeds in storage awaiting stratification, our restoration plantings will soon be scaling up from research to an operational stage. Fundraising to sustain the program continues to be our biggest challenge. We are looking forward to

(and campaigning hard for) the day when seed collections, seedling production and plantings of this keystone tree species become fully integrated into natural resources management operations in northern British Columbia and no longer rely on short-term charitable contributions. Despite important progress, that goal is still a long way off.

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Northernmost Limber Pine: Seed or Substrate Limited?

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Introduction

When attempting to understand plant regeneration dynamics, the question of seed or substrate limitation is always relevant. When biotic interactions such as white pine blister rust (WPBR) alter both the seed production capacity of stands, and their attraction to dispersers (McKinney et al. 2009), this question takes on new urgency. It is important to recognize that the reproductive ecology of high elevation, five-needled pines differ from many conifers in several key ways: they are large seeded (90+ mg), mast, show some seedbank dormancy, rely on vertebrate dispersers, and recruitment may last centuries because key substrates may remain open. Additional regeneration traits of limber pine make it particularly susceptible to seed limitation, notably its early succession status and occupancy of arid habitats (Turnbull et al. 2000).

Declining abundance of mature limber pine, and increasing infection rates in northern populations suggests that seed limitation will eventually affect some populations. WPBR monitoring efforts in southern Alberta show an increase in mean limber pine mortality (> 1.3 m tall) from 1996 to 2009, and an increase in infection levels at its northern limits in Kootenay Plains, AB, and the southern part of the Porcupine Hills region from 2003 – 2009 (Smith et al. 2013). While little information is available on substrate preferences of limber pine, it is known to establish in exposed, harsh sites, by virtue of its high seedling tolerance to heat and drought (Steele 1990).

As a first attempt to understanding natural regeneration dynamics in these landscapes, our objectives were to determine whether seedling densities differ between low and high WPBR study areas, whether variability in regeneration density is attributable to seed limitation, and whether substrate availability and substrate preferences of seedlings suggest substrate limitation.

Methods

The most common test for seed limitation is to add seed experimentally, and to examine whether regeneration increases (Turnbull et al. 2000). We used a natural experiment, where two landscapes with different levels of expected seed production (high WPBR, vs. low WPBR), were monitored for seed production, substrate availability, and natural regeneration. Our study areas represented two distinct geographic areas, 400 km apart, in the Montane Ecoregion in Alberta. We sampled nine stands in the low WPBR landscape (Kootenay Plains) and eight stands in the high WPBR landscape (Porcupine Hills / Crowsnest). Between 2008 – 2010, cone production, and cone escape from red squirrels was monitored annually (described in Peters 2012). During this period, regeneration < 50 cm tall was surveyed in a total of 108, and 96 plots in high and low WPBR study areas, respectively (12 plots/stand; 25 m^2/plot).

Substrate abundance was recorded in all plots according to the following % cover classes: 1 = 0 – 5 %, 2 = 5.1 – 10 %; 3 = 10.1 – 25 %; 4 = 25.1 – 50 %; 5 = 50.1 – 75 %, and 6 = 75.1 – 100 %. Substrates were classified as rock, scree (rock < 10 cm diameter), mineral soil, humus, needles, leaf litter, and moss. Additionally, we recorded the actual rooting substrate of each seedling. Seedling height and age was estimated non-destructively by counting all visible terminal bud scars, up to 20 years of age, as scars could not be reliably counted beyond this age.

We used generalized linear models to test variables that influence seed production (live limber pine BA, dead limber pine BA, cone production [years 2008 – 2010], and proportion cone escape from the 2010 mast year) and substrate availability ([rock, scree, mineral, needles, litter, humus, and moss], percent vegetation cover, basal area, slope, and aspect).

Results and Discussion

Seed Availability

Surprisingly, the landscape with high rates of WPBR infection produced 69.8% more cones per tree (2008 – 2010), and 50 % greater cone escape from red squirrels in a mast year (Figure 1; Peters 2012). Coupled with 35.2% more seed tree basal area/ha, our high WPBR landscape has considerably more seed available

for avian dispersers. This finding demonstrates that the high WPBR landscape had higher initial densities of limber pine prior to WPBR infection, and that these density differences have persisted despite a long-term presence of WPBR at high levels.

Regeneration – density

Despite higher seed production, recent seedling regeneration was significantly lower (2.4 times lower) in the high WPBR landscape than in the low WPBR landscape (Fig. 1). Seedlings were found in all nine stands in the low WPBR region (67 – 533 seedlings/ha), while no seedlings were found in two of the eight stands surveyed in the high WPBR region (0 – 233 seedlings/ha). Figure 1 clearly shows that recent seed availability is not limiting regeneration in the high WPBR landscape, suggesting some other ecological factor explains the lower regeneration densities.

Substrate availability

Seedlings showed a distinct preference for inorganic substrates, with disproportionately greater regeneration on mineral soil, rock, and scree seedbeds, than their availability at the sites. In the high WPBR landscape 45 % of seedlings occurred on inorganic substrate, despite comprising only 10 % of the available substrates. In the low WPBR landscape, 87 % of seedlings occurred on inorganic substrates (57 % of available ground cover). Cattle grazing and fire suppression has likely contributed to a successional shift towards an accumulation of organic matter, particularly in the high WPBR landscape. Overall, substrate and site effects explained twice as much of the variation in regeneration density in statistical models, as seed production within the stand; ironically, regeneration density was negatively associated with higher within stand seed production. This finding suggests that unsuitable substrates may be over-riding the benefits of within stand seed production.

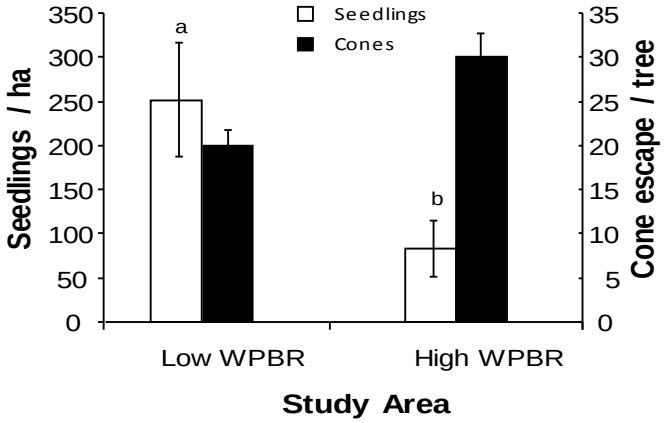

Figure 1: Seedling regeneration density relative to cones remaining following cone predation by red squirrels. Letters denote significant differences in regeneration densities between study areas.

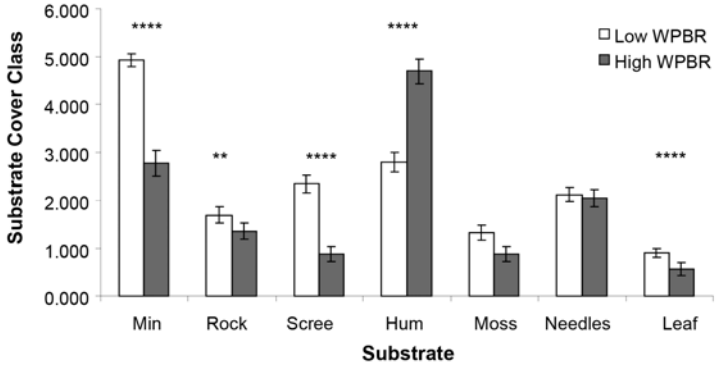

Figure 2: Substrate availability between different study areas. Cover classes are described in the methods. Symbols reflect significant differences in substrate cover ($p < 0.01$ (*), 0.001 (**), 0.0001, (***), 0.00001 (****).

Are differences in regeneration density simply attributable to substrate differences between the two landscapes? The 4.7 fold increase in inorganic substrates at the low WPBR landscape is certainly high enough to account for a 2.4 fold increase in seedling regeneration. Too little is known about limber pine seedling germination and survivorship stages to rely solely on this explanation. The observed specificity of limber pine seedlings for inorganic substrates may also arise from nutcracker caching preferences. If cache site preferences align with limber pines preferred regeneration niche, caching can compensate for the low prevalence of suitable germination substrates. One thing we can say; however, is that regeneration in the low WPBR landscape is not substrate limited, compared to the high WPBR landscape.

Seedling Age Structure – The Way Forward?

Seedling age structures suggest that WPBR may have influenced regeneration patterns; causing disproportionate mortality of recent seedlings. Landscapes with high WPBR infestations had proportionately fewer small seedlings than landscapes with low WPBR infestations (40 vs. 72.8 %, respectively, of seedlings < 25 cm tall). WPBR-induced mortality is known to be greater on seedlings, than on saplings, and older trees (Smith et al. 2013).

Conclusions

These results suggest that community-level interactions such as disease may interact with regional differences, such as substrate, to override the availability of seed, in determining seedling population size. Although our study provides data that supports this explanation, we recognize that nutcracker caching behavior in these landscapes remains a wildcard. Until a detailed study on nutcracker dispersal occurs at the northern limits of limber pine distribution, we can not say whether either of our landscapes are disperser limited.

Acknowledgements

We thank Alberta Tourism, Parks and Protected Areas, and the Alberta Conservation Association for financial support, and numerous undergraduate researchers.

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New Range Maps for Whitebark and Limber Pine in Canada

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Whitebark (WBP) and limber (LP) pine are both legally listed as Endangered under *The Wildlife Act* in the Province of Alberta (Government of Alberta 2010), and WBP is also listed as Endangered in Canada federally under the *Species at Risk Act* (*SARA*; Government of Canada 2012). As recovery planning for both species began, it became apparent that existing range maps (e.g., Critchfield and Little 1966, Little 1971, Ogilvie 1989) were misleading and out-of-date in Canada. In particular, portions of the range were mapped with different standards, resulting in large polygons of apparently contiguous occurrence in Canada and a more finely grained pattern of smaller, often disjunct polygons in the U.S.A.

Thus we began the process of building new range maps to a common standard of scale and minimum polygon size. We gathered existing GIS layers from individuals and agencies (ACIMS 2013), applying lower elevational cut-offs (for WBP), and buffering locations of plots, transects and random observations. We then did an iterative process of sending the resulting maps out to field staff for review, tweaking the maps based on responses, and sending them out again. As we solicited information from US colleagues to make a seamless transition across the international border, we were encouraged to expand our work to the entire range for both species in North America, which we did. The improved resolution is especially obvious for whitebark pine (Fig. 1), while the limber pine range had fewer changes (Fig. 2).

In the interest of making these maps widely available, and to encourage corrections and feedback, this range map project is being hosted on the Whitebark Pine Ecosystem Foundation's website <**www.whitebarkfound.org**>. There you will find GIS files in different formats, as well as some ready-to-use range maps in black-and-white and colour for. Note that these are BROAD scale maps, not suitable at the level of stand

Figure 1. New range map of whitebark pine in North America superimposed on the old range map by E. L. Little, Jr. (U.S. Geological Survey 2013).

mapping, for instance. We wish to thank all of the individuals who provided input, but rather than take space in this article to list them, we have provided a complete list on the website.

We suggest three ways to provide feedback so that we can continue to improve the accuracy of these maps as new information becomes available: 1) copy the shape files, make corrections, then save the files with your name and the date, 2) send polygons or point data directly, or 3) draw changes on a hard copy and then scan it. In all cases, please send corrections to adam.collingwood@pc.gc.ca. Suggested citation for the shape files: Whitebark Pine Ecosystem Foundation. *2014*. Whitebark pine and limber pine range maps. Available online from http:\whitebarkfound.org [accessed *date*].

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Figure 2. New range map of limber pine in North America superimposed on the old range map by E. L. Little, Jr. (U.S. Geological Survey 2013).

Survival of Whitebark Seedlings Inoculated With Ectomycorrhiza

Cathy L. Cripps and Erin R. Lonergan, Montana State University, Bozeman, and Cyndi Smith (Scientist Emeritus) Parks Canada, Waterton Lakes National Park, Alberta

Introduction and Methods

It has become widely accepted that restoration of whitebark pine (WBP) in areas that have been heavily impacted by white pine blister rust (WPBR) will require the planting of nursery-grown potentially rust-resistant seedlings (e.g., Keane et al. 2012). One of these areas is Waterton Lakes National Park (WLNP) in southwestern Alberta, where WPBR infection and mortality (from all causes) on eight plots averaged 78% and 65%, respectively, in 2009 (Smith et al. 2013). In 2010, we initiated a study into the effects of planting in small prescribed burns, in dense understory, in microsites, and with inoculation with native ectomycorrhizal (ECM) fungi (Lonergan et al. 2014). Here we briefly describe our methods (full details can be found in Lonergan et al. 2014) and the results of three years of monitoring these seedlings.

Five weeks before planting two-year-old seedlings grown from seeds of potentially rust resistant trees, 478 of them were randomly selected in the nursery and inoculated with a spore slurry made from sporocarps of the ECM fungus *Suillus sibiricus*. On Sept. 28, 2010, 983 WBP seedlings were planted within 21 plots near Summit Lake (elevation 1950 m). Approximately half of each 50-m diameter plot was burned in 2009 or 2010 using a terrestrial torch to reduce competing Engelmann spruce, subalpine fir and understory vegetation (Schwanke and Smith 2010), in particular beargrass. Seedlings were planted in clusters of three, with none, one, two or three inoculated seedlings in each cluster. Un-inoculated seedlings that were planted with inoculated seedlings were considered "exposed." The final experimental design consisted of nine treatments: burned/unburned, beargrass/no beargrass, microsite (yes/no), and the three inoculation treatments. All of the seedlings were monitored for survival in August 2011, 2012 and 2013. A seedling was considered "dead" if all needles were brown or gone or "alive" if some portion of the needles were green.

Results and Discussion

Overall seedling survival was 95% one year after planting and this dropped to 69% in year two. These high survival rates are likely due to particular treatment combinations possibly helped by favorable spring moisture conditions (Lonergan et al. 2014). In year three, overall seedling survival dropped to 47%.

One year after planting, seedling survival was high across all site conditions ranging from 88-98% (Fig. 1). Two years after planting, the highest seedling survival was on burned areas without beargrass (82%). Three years after planting, survival was highest on burned areas whether beargrass was present (50%) or not (57%). In the two-year assessment, survival was also high in un-burned areas with beargrass, especially when seedlings were inoculated with ECM fungi and planted near shelter objects (Lonergan et al. 2014). By year three, the overall survival on un-burned sites with beargrass dropped to 33%, which suggests that competition from beargrass may now be a factor. Seedlings planted in un-burned areas devoid of beargrass had the lowest survival rate (18%) after three years. This likely reflects poor site conditions; here the soil was often hard, rocky and exposed, and there may have been mechanical difficulties with planting. Results suggest the importance of site preparation/selection prior to planting whitebark pine seedlings.

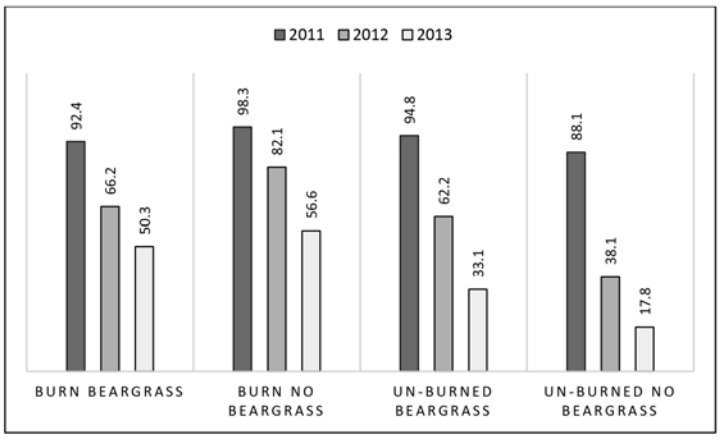

Figure 1. Seedling survival by site conditions over three years.

Planting within a microsite increased seedling survival by 11% overall across all sites after one year, and this increased to a 21% advantage in year two and 18% in year three, highlighting the value of planting seedlings with shelter objects (Fig. 2). After three years, planting in microsites was most valuable in the burned areas; here survival was increased 23% when beargrass was absent and 11% when it was present (Fig. 3). It should be kept in mind that on burned sites, the "presence of beargrass" refers only to the roots since the top vegetation layer was torched. It was also interesting that data taken in year two showed that planting in microsites improved survival 31% on the poorest planting sites (un-burned ground without beargrass), but by year three this initial boost from microsite was negated.

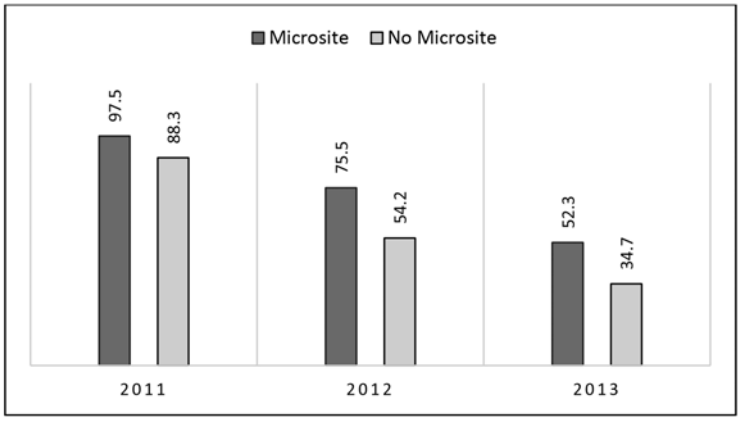

Figure 2. Three-year survival of seedlings planted in microsites.

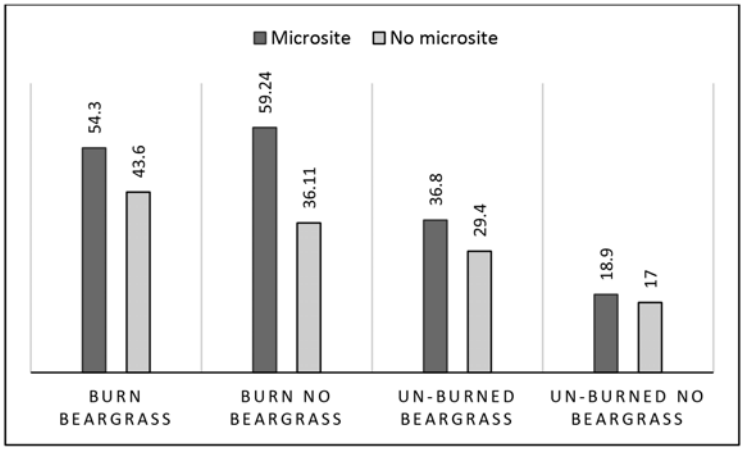

Figure 3. Three-year survival of seedlings by microsite and site conditions.

Inoculation with ECM fungi did not impact seedling survival overall in 2011, likely because survival rates were still high (92-95%) so treatment effects were masked (Fig. 4). After two years, mycorrhizal inoculation increased the overall seedling survival 6% and in year three it increased seedling survival 11% over un-inoculated controls. If this trend continues, then inoculation with native fungi is worth the investment. Results for the (exposed) seedlings planted adjacent to inoculated seedlings are less clear.

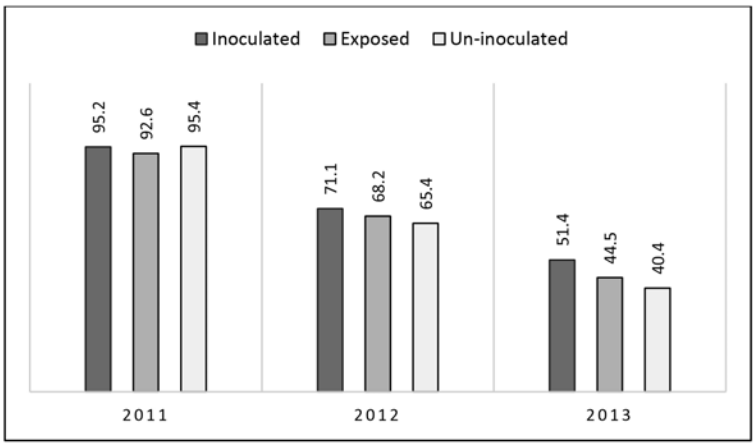

Figure 4. Three-year survival of seedlings that were 1) inoculated with native mycorrhizal fungi, 2) planted next to inoculated seedlings (exposed), or 3) not inoculated.

After three years, inoculation with ECM fungi increased seedling survival on the burned sites by 15% when beargrass was present and 6% when it was not (Fig. 5). Initially (after two years), mycorrhizal inoculation increased survival 17-24% on un-burned sites with beargrass (Lonergan et al. 2014), but this advantage dropped to 10% in year three. Results appear negative on the rocky un-burned sites without beargrass and are not explicable at this point; however, a bias may be the loss of whole clusters for mechanical reasons or the fungi may not have been able to survive the harsh conditions. Results are all for comparisons to un-inoculated seedlings, since results are less clear for exposed seedlings at this point.

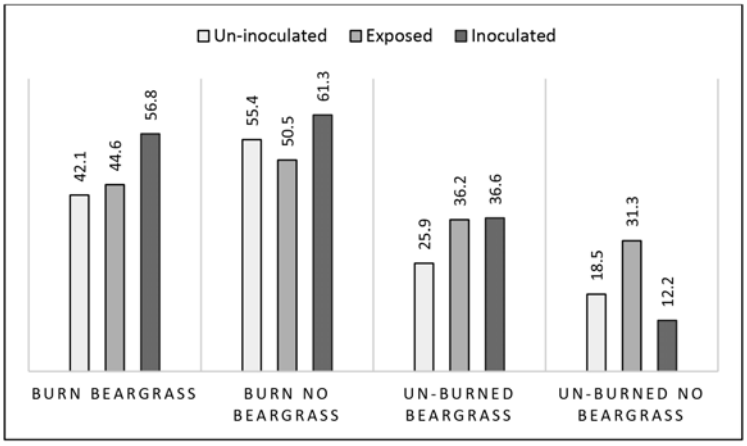

Figure 5. Three-year survival of seedlings inoculated with native mycorrhizal fungi, exposed or not inoculated, in different site conditions.

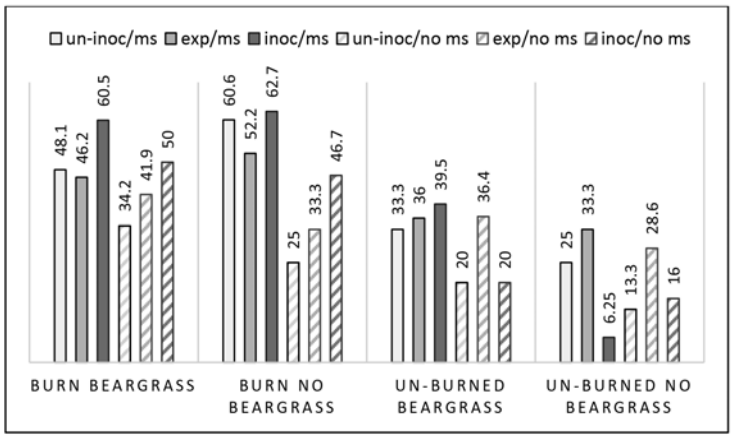

Figure 6. Seedling survival three years after planting for four site conditions, planted with/without microsite (ms), and with/without inoculation with native mycorrhizal fungi (or exposed to inoculated seedlings).

Conclusions and Recommendations

In the larger scheme of things, the highest survival rates for whitebark pine seedlings recorded after three years were on the burned sites (Fig. 6). Here, seedlings planted with shelter objects and inoculated with ECM fungi, whether with beargrass (60.5%) or without beargrass (63%) had the highest survival rates; those planted in microsites on burns devoid of beargrass, but without inoculation, also had a high (61%) survival rate. This research highlights the value of selecting appropriate sites for planting whitebark pine seedlings grown in containers. From our data we recommend planting in burns (or at least small torched areas), with shelter objects (microsite) and if trends hold, results show inoculation with ECM fungi can further benefit survival on some site conditions. Seedlings need to be inoculated in the greenhouse weeks or months prior to planting for this strategy to be effective (Lonergan et al. 2013). Continued monitoring will determine which factors will enhance the survival of whitebark pine in the long run.

Acknowledgements

We thank the Glacier Park Native Plant Nursery and revegetation crew, WLNP staff (especially Queenie Gray who monitored the seedlings in 2013), and volunteer planters, for their assistance. Funding was provided by Parks Canada's *Restoring Terrestrial Ecosystems Together* project.

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Whitebark Pine Seed Orchard on the Lewis and Clark National Forest Service

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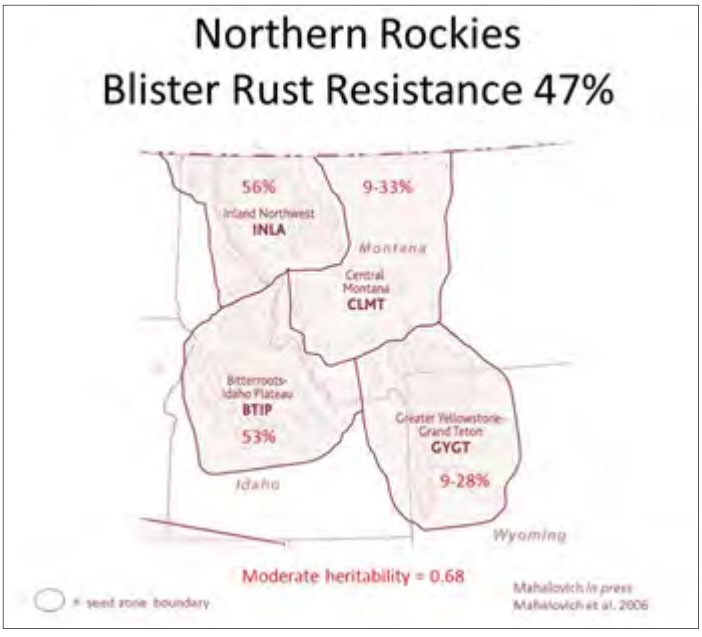
Since 2011, the Lewis and Clark National Forest has been proud to host the Central Montana seed zone's Adams Creek whitebark pine seed orchard. The orchard is part of the Northern Region's Genetic Resource Program and the Intermountain Whitebark Pine Restoration Program with the objective of producing whitebark pine seed with improved white pine blister rust resistance for planting within the seed zone. The Central Montana zone is composed of all or portions of the Beaverhead-Deerlodge, Bitterroot, Gallatin, Helena, Lewis and Clark, and Lolo National Forests. Partnerships with other agencies and organizations within the geographic area could expand the orchard's contribution to restoration.

As the orchard is cultured for early and abundant flowering, rather than chasing periodic cone crops across the landscape, Adams Creek will provide a reliable cone crop among partners for immediate restoration planting needs. Aggregating valuable whitebark genetic material in a central location enhances our ability to effectively protect the resource from wildland fire, insect, and disease loss compared to individual elite trees across the forest.

The orchard is situated approximately 53 miles southeast of Great Falls, Montana, at 7300 feet in the Adams Creek drainage of the Little Belt Mountains. The 1.5-acre orchard is designed for 33 genotypes replicated five times (165 whitebark pine) on a 20-foot by 20-foot grid. There is potential to expand the orchard to meet increasing restoration seed needs from partners. As of September 2013, Forest Service employees representing all disciplines have successfully fall planted 14 genotypes (39%). Annual planting will continue until the orchard planting design has been achieved. Although some grafts have died or shown stress, the planting design has 100 percent survival due to double-planting at each site.

For the past several decades, forests in the seed zone identified and collected seed from mature whitebark pine with phenotypic blister rust resistance, also known as plus trees. Their seedlings are grown at the Coeur d'Alene Nursery, artificially inoculated with blister rust, and then subjected to several rust screening assessments to determine their genetic rust resistance levels. Results from the rust screening



Whitebark pine seed zone map for the Northern Rockies indicating rust resistance levels among the four zones.

analysis indicate those genotypes, now promoted to elite tree status, to be cultured in the orchard. Based on the recently completed (2013) rust screening for the Central Montana seed zone, orchard entries were revalidated and two genotypes with less than desirable blister rust resistance were removed from the orchard. White pine blister rust resistance for this seed zone ranges from 9 to 33 percent. Our top-performing elite trees are Cinnabar Point on the Lolo National Forest, followed by Bare Cone and Willow Mountain on the Bitterroot National Forest.

Scion from elite trees with proven, high rust resistance are collected and grafted onto root stock to create chronologically mature trees able to produce cones in 10 to 15 years. Based on current seed procurement plans, forests in the Central Montana seed zone have an annual need for approximately 86 pounds of seed to support a 454-acre planting program. Seed needs are substantially higher for large-scale disturbance restoration efforts.

Infrastructure at the orchard currently consists of an 8-foot wildlife fence and a gravity fed drip irrigation system. On-going activities include data

Planting in 2013.

management, survival surveys, water system and fence maintenance, watering, and insect and disease monitoring. Fertilization, crown and pollen management, floral induction, cone protection and collection, insect and disease prevention and control, understory vegetation management, and fire control are all activities that will occur over the next one to two decades.

During this calendar year, a seed orchard management plan is being developed to document seed orchard establishment, maintenance, and culturing early and abundant cone production of the next 10-year window. In addition, informational signs will be posted at the orchard to educate the public about the whitebark pine genetic program and its significance in future restoration.

Additional information on the genetics program is available at the following link (Whitebark Pine Genetic Restoration Program for the Intermountain Region) http://www.fs.fed.us/rm/pubs/rmrs_p032/rmrs_p032_181_187.pdf. ■

Successional Dynamics of Whitebark Pine

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Ecosystem and Conservation Sciences,
University of Montana

Despite widespread concern about threats to whitebark pine (*Pinus albicaulis*), there is limited understanding of its successional dynamics, especially in forests disturbed by white pine blister rust (*Cronartium ribicola*) and mountain pine beetle (*Dendroctonus ponderosae*). For instance, despite evidence that mountain pine beetle, white pine blister rust, and altered fire regimes could facilitate recruitment of late-seral species such as subalpine fir (*Abies lasiocarpa*) (Keane 2001; McKinney et al. 2009; Kegley et al. 2010) and reduce availability of canopy openings thought to be necessary for whitebark seedling recruitment (Tomback 1982; Schwandt 2006; Keane and Parsons 2010), the rate and extent of this successional replacement across the tree's range is unknown (Rochefort 2008; Larson and Kipfmueller 2012). Assessing successional dynamics, however, is a data intensive endeavor - requiring multiple re-measurements over long time-periods. Obtaining these data is challenging in any forest ecosystem, but particularly so for whitebark pine stands, which occur at high elevation where sampling seasons are short and stands are often difficult to access. One strategy for increasing the power to detect changes in stand conditions is to sample previously measured plots; this approach not only increases the length of the assessment period, but also specifically allows for distinguishing effects of time and disturbance from variation in initial conditions.

We were able to take advantage of a re-measurement opportunity on the Okanogan-Wenatchee National Forest (eastern Cascade Mountains of Washington State) to ask questions about the frequency of bark beetle and blister rust disturbance in

seral and climax whitebark pine stands and the effects of these disturbances on tree community composition and whitebark pine population dynamics. We surveyed plots that had been previously installed as part of the Current Vegetation Survey (CVS) program established by the US Forest Service in the early 1990s for the purpose of characterizing vegetation and assisting with landscape-level planning and monitoring. CVS plots were established from a random point within the Forest and placed systematically across the landscape on a 2.74-km grid (the CVS program later was subsumed by the USFS Forest Inventory and Analysis program). CVS plots chosen for our study were sampled once between 1991 – 1998 (hereafter, "Cycle I") and again between 2001 and 2007 (hereafter, "Cycle II) by USFS personnel. In 2012 (hereafter, "Cycle III"), we re-measured all CVS plots located on the Forest where: 1) whitebark pine was the dominant or co-dominant tree species at the time of establishment, 2) the site was sampled during both previous sample cycles, and 3) the site was located outside of designated wilderness areas. A total of 19 plots on the Forest met these criteria, seven seral stands in which subalpine fir was the dominant tree species and 12 climax stands in which whitebark was the dominant. At each site, we collected data on tree species composition by size class, and mountain pine beetle, blister rust, and wildfire incidence and severity. We also collected data on seedling microsite conditions (not reported here).

Over the 22-year period, five of 19 sites (26%) experienced wildfire (1 seral and 4 climax), 11 were disturbed by mountain pine beetle (58%) (2 seral and 9 climax), and 13 were infected by white pine blister rust (68%) (6 seral and 7 climax). Only one showed no evidence of disturbance by any of these agents. Among sample cycles, the only species and size class to show significant differences in basal area (BA) was mature whitebark pine, which on average, declined by about 55% over the 22-yr period at both climax and seral sites (Figure 1). Observed differences over time in mature whitebark abundance were significant when climax communities were analyzed separately, but not for seral stands when analyzed on their own. We did not detect significant differences among sample cycles in BA of pole or sapling size classes of whitebark pine, in density of large whitebark pine seedlings, or in any size class of subalpine fir or Engelmann spruce (*Picea Engelmannii*) (for complete results, see Amberson 2014).

Fire was an important factor in the reduction of mature whitebark pine, especially at high-elevation sites; of the five stands that experienced wildfire, four were in climax communities. The five stands that burned showed the highest reductions in whitebark, with an average decline of 78%. When burned sites were removed from the analysis of climax communities, BA of whitebark pine did not vary significantly among sample cycles.

Our results indicate that successional replacement of whitebark pine by subalpine fir (Larson and Kipfmueller 2010; 2012) may not be a ubiquitous threat. The relative abundance of whitebark pine and subalpine fir was consistent over the 22-yr period. Thus, even though whitebark occurred at lower relative abundance than subalpine fir at many sites in this study and elsewhere (e.g. Kegley et al. 2010), this pattern is not necessarily an indication of accelerated successional replacement. Even a 22-yr remeasurement cycle, however, may not be long enough to detect significant shifts in tree species composition and regeneration trajectories.

To date, studies of successional dynamics in whitebark pine ecosystems have relied largely on dendrochronology (Campbell and Antos 2003; Kipfmueller and Kupfer 2005) and computer-based modeling (Keane 2001). Our work highlights the benefits of using long-term re-measurement data to assess community and population-level trends in tree abundance and response to disturbance. There may be additional, yet unexplored re-measurement opportunities that would allow for further investigation of the role of disturbance on succession range-wide; resampling these areas and plots should be a high priority for those interested in successional dynamics in whitebark pine. Managers and researchers with knowledge about additional re-measurement opportunities are invited to contact Cara Nelson (cara.nelson@umontana.edu) to explore possibilities for collaboration.

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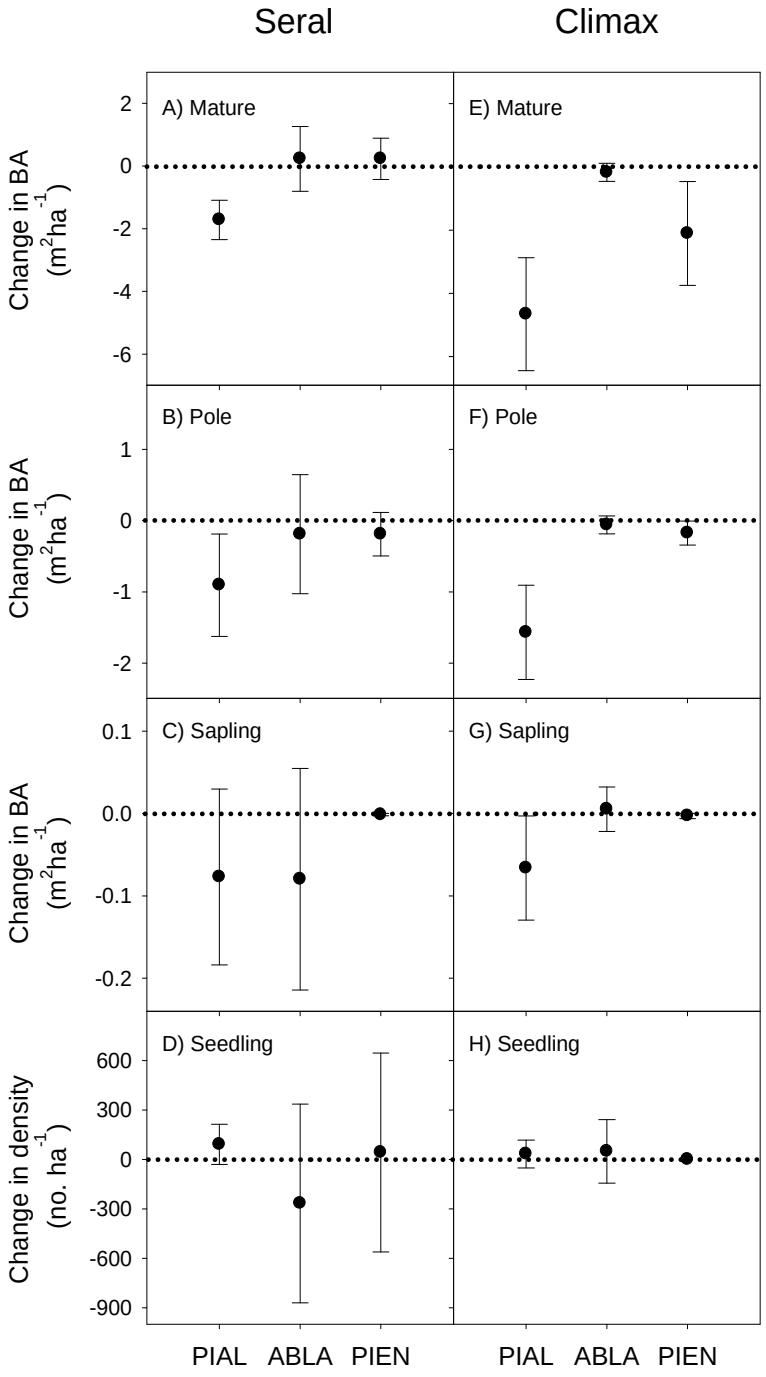
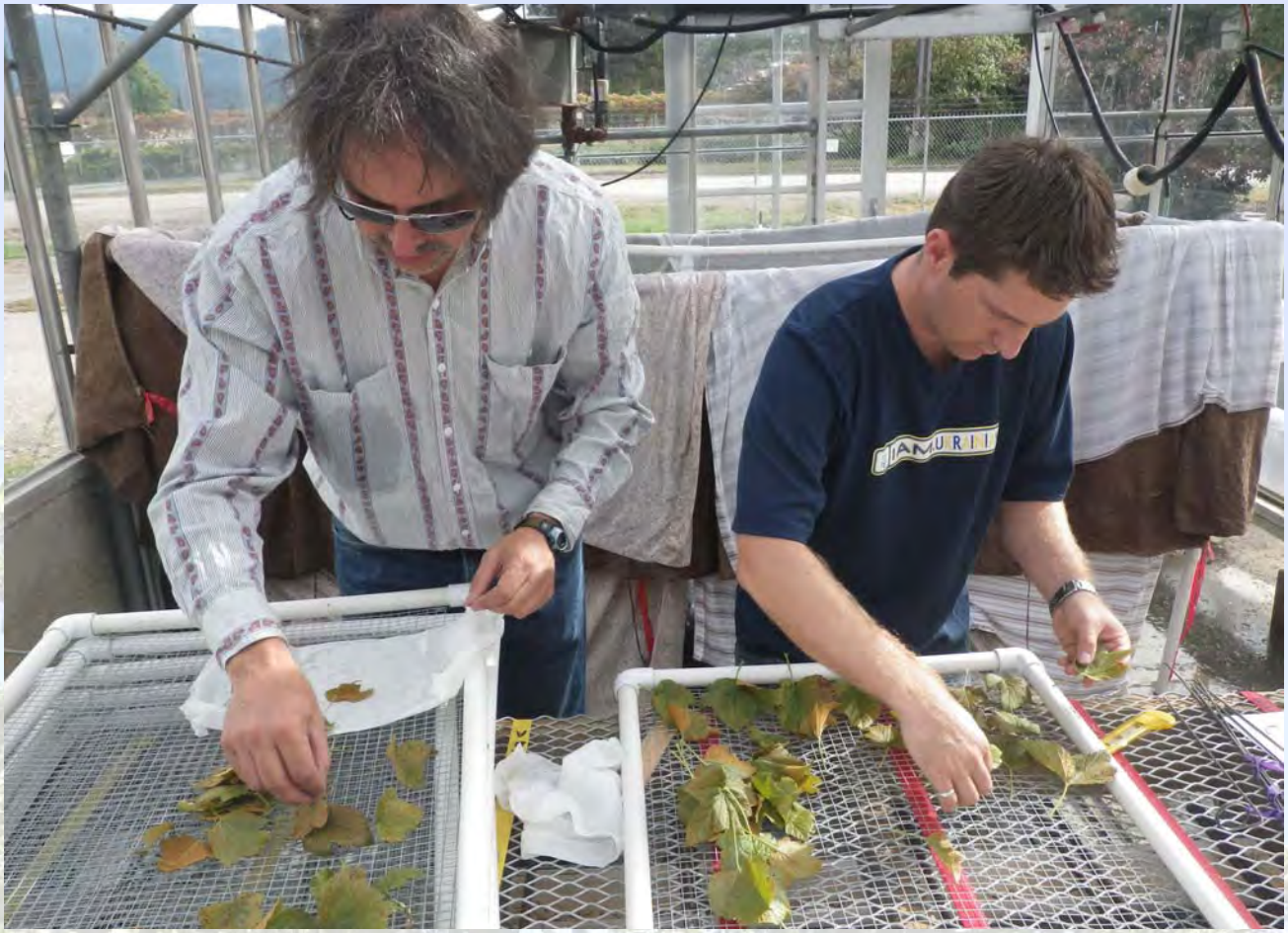


Fig.1. Mean change (+/- 1 SE) in basal area of mature (≥20-cm DBH), pole (< 20-cm DBH but ≥ 7.62-cm DBH), and sapling (< 7.62-cm DBH but ≥ 2.54-cm DBH) trees and mean change (+/- 1 SE) in density of seedlings (≥ 15-cm tall but <2.54-cm DBH) between Sample Cycles I and III for the three most common species (PIAL=whitebark pine, ABLA=subalpine fir, and PIEN=Engelmann spruce). Panels A-D = seral stands (n=12); Panels E-H = climax stands (n=7).



Placing *Ribes* leaves over whitebark pine seedlings for rust inoculation, see Murray article."

"Whitebark pine seedlings at Coeur d'Alene Nursery to be seen at WPEF's September conference."