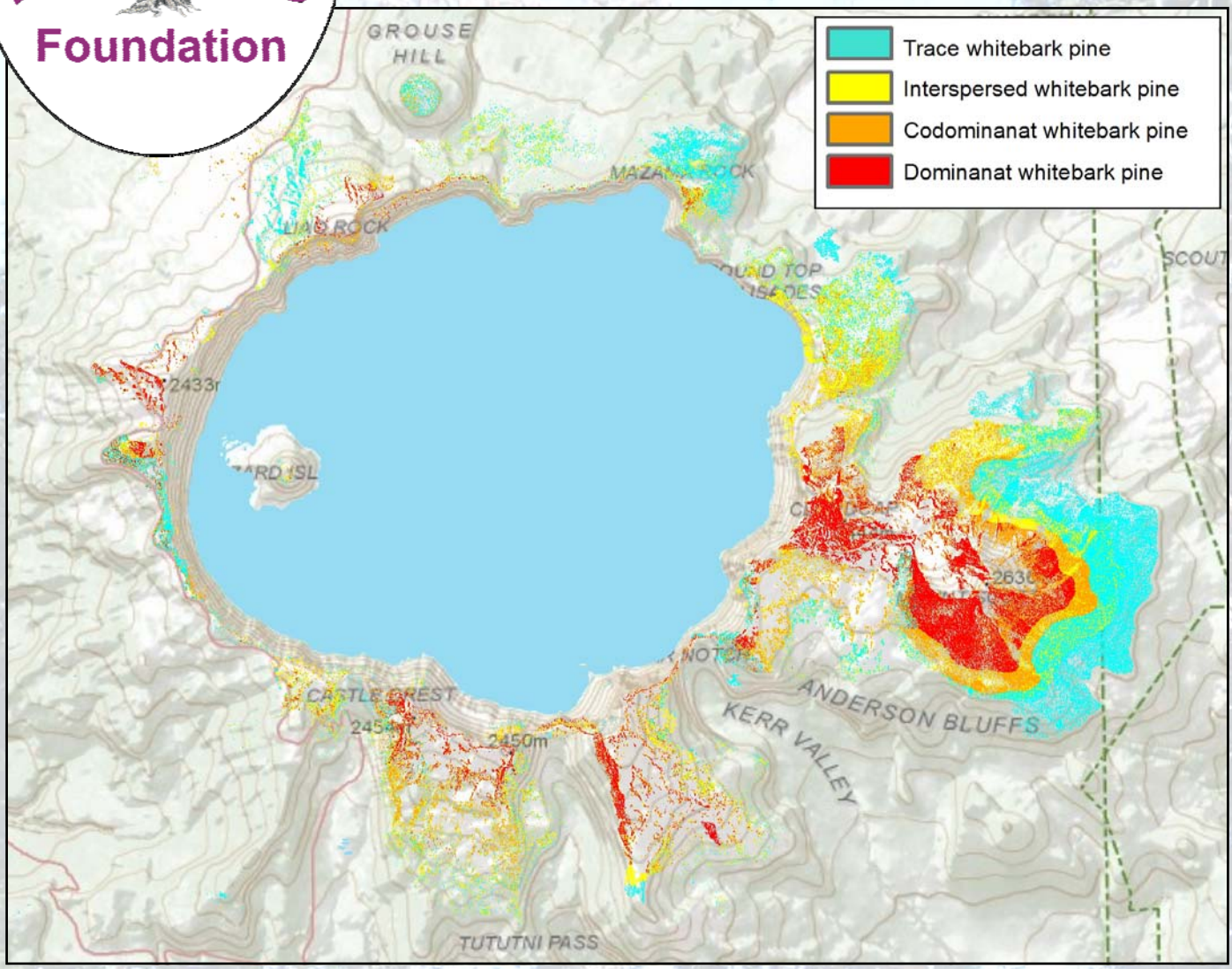
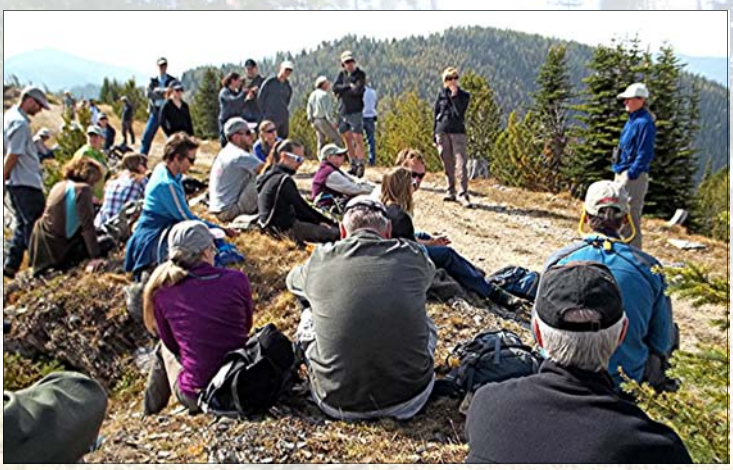
Issue No. 23: Fall / Winter 2012-2013

Nutcracker Notes



Mapping at Crater Lake



WPEF's Kimberley Field Trip

WPEF
P.O. Box 17943
Missoula, MT 59808

Whitebark Pine Ecosystem Foundation

***Nutcracker Notes,* Issue No. 23; Fall/Winter 2012-2013**

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Web Site: **www.whitebarkfound.org**

Web Site Contact Person: Libby Pansing
elizabeth.pansing@ucdenver.edu

Web Site Provider: Chuck Crouter

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>

*USDA Forest Service Rocky Mountain Research Station
Fire Sciences Lab
5775 West US Highway 10
Missoula, MT 59808-9361

Director's Message

Diana F. Tomback

Whitebark Pine "Endangered" in Canada

Probably the most important current news for our membership is that whitebark pine was declared "Endangered" in Canada on June 20, 2012, through the Species at Risk Act (SARA). This is a major achievement for Peter Achuff, formerly National Botanist with Parks Canada, who was lead author of the whitebark pine status report, and for co-author Brendan Wilson of Selkirk College. Peter has been following the petition as it moved through the multi-step review process over the last few years. Deserving acknowledgment as well are the researchers and managers who, over the last decade or so, conducted methodical surveys and provided supporting information on the status of whitebark pine throughout its range in western Canada. Prior to this federal decision, whitebark pine and limber pine had been listed in Alberta as 'Endangered' under the provincial Wildlife Act. A draft Recovery Plan for the province of Alberta is nearly completed and will soon be available for review.

I sincerely hope that federal listing in Canada brings more attention to the status of whitebark pine and facilitates the outreach work of our colleagues with the Whitebark Pine Ecosystem Foundation Canada. I have been told, however, that the listing of whitebark pine under SARA does not guarantee that funding will follow. We are tracking this intently to see if the higher profile for whitebark pine results in additional provincial mandates and support for designing and implementing restoration plans. If this is the case, federal listing in the United States for whitebark pine may well help our current efforts.

Blister Rust and Whitebark Pine "Up North"

The widespread and rapid loss of cone-bearing whitebark pine in the Greater Yellowstone Area has garnered much public and media attention. The dramatic mortality has resulted from a mountain pine beetle outbreak at a scale some researchers have called "unprecedented", driven by more than a decade of mild winter and warm summer temperatures. But whitebark pine in the Greater Yellowstone Area is also challenged by increasing infection levels of white pine blister rust, which kills trees of all ages—from seedlings to mature cone-bearing trees. Blister rust can kill small trees within a few years, but take a decade or longer for mature trees, depending on whether the stem or canopy is infected. In areas with high incidence of blister rust infection, the resulting high rust spore loads may infect and kill even the youngest whitebark pine regeneration and prevent natural recovery of stands. Yellowstone, considering all the mortality that has occurred, still has some healthy cone-bearing trees. The Whitebark Pine Strategy of the Greater Yellowstone Area, Whitebark Pine Subcommittee recognizes all these factors and is designed to implement a multi-faceted restoration plan (see Nutcracker Notes, Spring/Summer 2012), which includes planting blister rust resistant seedlings.

Farther north, in the Northern Continental Divide Ecosystem and Intermountain Region of both the U.S. and Canada, the situation is different but also calls for immediate and strategic management intervention. In these regions, decades-old whitebark pine ghost trees, victims of two major 20th century mountain pine beetle outbreaks, are scattered along the ridgelines and across steep slopes. Here, there are fewer of the red canopies that signal a tree recently killed by mountain pine beetle. Instead, canopies have branches either bark-stripped or red-flagged, resulting from very high infection levels of white pine blister rust. The whitebark pine mortality in these areas is not the "flash death" from mountain pine beetle but slow and protracted—the trees die part by part. As indicated by extensive surveys, most recently by Cyndi Smith and colleagues (in press), these regions have the highest blister rust infection rates, damage, and mortality of whitebark pine's entire range.

This past summer, I saw examples of these extremely high blister rust infection levels in these two different areas. My students and I were working at the interface between the subalpine and treeline and in the alpine-treeline zone on White Calf Mountain, on the east slope of Glacier National Park, and we were literally pressed to find a tree that was not infected by blister rust. In this region, whitebark pine serves as an important tree island initiator, and in a number of tree islands, the windward whitebark pine was already dead or nearly dead from blister rust, exposing leeward trees to the wind. In several tree islands, the leeward spruce or fir trees were also damaged or killed from exposure.

At the annual Whitebark Pine Science and Management Wokshop in Kimberley, B.C., this past September, our fieldtrip took us to Puddingburn Mountain in the Purcell Range (see conference description in this issue). As we drove up the service road to the summit, we saw that red foliage flags and bare branches were common within an extensive

whitebark pine community. As we hiked the ridgeline trail, many whitebark pine trees initially appeared healthy, but closer inspection revealed branch and stem cankers. As on White Calf Mountain, we were hard-pressed to find trees that were not infected. Given the low mortality and lack of major canopy kill, it appears that the high incidence of blister rust in this population is comparatively recent. For both of these areas, natural blister rust resistance appears to be low, and restoration planting of seedlings with some level of resistance as soon as possible would be a good strategy.

Articles in *The Salt Lake City Tribune*

Salt Lake City Tribune reporter Brandon Loomis and photographer Rick Egan attended our Kimberley conference. They also joined us on our fieldtrip to Puddingburn Mountain, using the opportunity to take pictures and ask questions about what we were seeing. Brandon and Rick had the good fortune to see the best and the worst of this mountaintop whitebark pine ecosystem. The whitebark pine along the ridgetop had good cone production, and all along the trail, nutcrackers were noisily interacting, harvesting seeds, and flying off in many directions with filled pouches—planting future trees. But, the high incidence of blister rust was clearly evident, and made an impression. Rick took many pictures of cankers that had recently sporulated, some with large patches of rodent-gnawing, hastening the branches' demise. Randy Moody, Kate Kendall, and I also did video interviews. The story and pictures were published on October 28th both in print and online: "Dark days for whitebarks—and for birds, bears and fish" (www.sltrib.com). Also posted is a companion article, with an interview with Jesse Logan and colleagues, "Whitebark warriors have not yet begun to fight." We are very grateful to Brandon and Rick for publicizing the whitebark pine issue and for their excellent reporting.

Rangewide Strategy Published

This past June, the Rocky Mountain Research Station published "A range-wide restoration strategy for whitebark pine (*Pinus albicaulis*)" (General Technical Report RMRS-GTR-279), by Robert E. Keane and co-authors, a comprehensive document under preparation for several years. The strategy is available both as a pdf and as a hard copy (see the article about it in this issue). The strategy presents a background review and then proceeds to discuss the nuts and bolts of restoration at scales varying from regional to tree, with examples of existing plans at each scale. This document actually provides the platform for a recovery plan for whitebark pine across its range. The next step would be to select core restoration areas which could be expanded as funding becomes available.

Housekeeping and Misc.

One of our founding board members, Kate Kendall, grizzly bear biologist with U.S. Geological Survey based in Glacier National Park, chose to step down this year. Several of us have worked side by side with Kate on the whitebark pine issue since we were previously part of an interagency whitebark pine research team assembled in the mid-1980s. Kate [who is artistically talented] designed our t-shirts, hat insignias, and "big tree" logo, and has been in charge of overseeing our WPEF "merchandise" for many years. On behalf of the board and membership, I would like to express our sincere thanks to Kate for her time and support to the WPEF since its inception.

We regret that board member Kirk Horn also chose to step down this year. Kirk and spouse Beth have helped us with registration and with merchandizing at our annual Science and Management workshops for many years. Kirk's experience as a wildlife biologist and board member for the Rocky Mountain Elk Foundation have proven invaluable, as well as his support for strategic planning in the WPEF. He has made it in person to nearly all of our board meetings, often a feat during the unpredictable late winter/early spring weather, when we meet in Missoula. We thank Kirk for his service and encourage him and Beth to stay active in the WPEF.

We congratulate Bryan Donner, another founding WPEF member, for his re-election as Membership and Outreach Coordinator and appreciate his years of service in this role. Shawn McKinney was re-elected as a board member, and Vick Applegate has become our new Treasurer. The duties of Treasurer are expanding with our recent MOU with Region 1, and it is more of a "chief financial officer" position. This past summer, WPEF's board of directors elected Liz Davy, district ranger in the Caribou-Targhee National Forest, and Gerry Gray, Senior Vice President for Conservation Programs at American Forests, as our newest board members, replacing the two board members who have stepped down. Liz has already served the WPEF as both organizer of two Science and Management Workshops and also as a member of our Development Committee. Please note that our 2013 Science and Management meeting will be held at Montana State University in Bozeman, with a fire ecology theme.

Finally, as I write this message, it is not at all clear what funding priorities will emerge from negotiations between the second-term Obama Administration and the somewhat new Congress. But, it is imperative that we make whitebark pine a bipartisan issue and engage our congressional

delegates in the fight to prevent our whitebark pine ecosystems from experiencing regional extirpation. For some regions clearly, this challenge is most critical, because we are losing this magnificent resource more rapidly than even we had predicted. ■

Director's Message: WPEF Canada

Randy Moody

This message is one of the easier and more promising ones I have had to write during my short tenure. For starters, the Kimberley meeting was very well received, and we thank everyone who travelled from afar to attend this event. Just looking at the figures, of roughly 60 attendees, about 90 percent travelled from more than three hours away – a strong testament to the dedication people have to the whitebark pine ecosystem. It appears we got a bit of a Canadian bump in membership at the meeting as well, but be aware that it is time to renew so let's keep those Canadian memberships up and encourage friends and colleagues to join.

Most of the attendees participated in the first field day, to Puddingburn Mountain, but the optional, second field day to a remote alpine larch ecosystem was also a great affair. Many thanks to local outdoorsman Blake Rawson for guiding us to this interesting site.

As there is a new audience of Canadians reading this, I want to remind everyone that our Canadian group maintains its own website to deal specifically with the Canadian context of whitebark pine. We have set-up a forum on our website that you can sign in to in order to generate conversation around whitebark pine – Let's use it! I also want to remind everyone that your Canadian board members each have some merchandise including T-shirts, bumper stickers, and calendars, so if you are looking for the ultimate in Christmas giving please get in touch with me <Randy@keefereco.com>.

As most of you are aware, whitebark pine is now listed under SARA as was discussed in-depth by Peter Achuff at the annual meeting . Many British Columbians looked on with envy as Peter's talk was followed a short time later by Brad Jones speaking about recovery planning in Alberta. Well, I am pleased to report that it sounds like the BC Government has finally initiated a process to address whitebark pine – this is hot news, only a day old as I write this. Although only embryonic, it is still a glimmer of hope, and I imagine if we had the annual meeting in BC all over again, we would have an infusion of new attendees from the government level– wishful thinking perhaps, but possible.

Since this message has mainly been about our recent meeting and a hypothetical meeting, I may as end on that note as well. While I certainly encourage as many Canadians as possible to attend the conference next year in Bozeman, I recognize that travelling is not always easy. Therefore, we plan to have at least one meeting in Canada each year to discuss whitebark pine issues. In spring 2013, the Canadian Forest Service will be hosting the Intermountain Forest Health Meeting tentatively scheduled for Canmore, Alberta. We are planning to have a 5-needle pine session at this event, so watch for news on this. ■

Save the Date: WPEF 2013 in Bozeman

WPEF's 2013 annual Science and Management Conference is scheduled for Friday and Saturday, September 20-21 in the vibrant city of Bozeman, Montana, gateway to the Yellowstone Ecosystem. Bozeman is central to many whitebark pine restoration projects, and this meeting is special in being co-sponsored by the Northern Rockies Fire Science Network (http://nrfirescience.org/), which will add depth to our agenda. Friday's conference will be held at Montana State University, and is tentatively titled, "Challenges in Whitebark Pine Restoration: Fire, Wilderness, Bears, and Lynx". On Saturday we will visit nearby whitebark pine forests and hear from local experts about different features of the ecosystem. Please contact program chair Bob Keane (rkeane@fs.fed.us) if you would like to give a presentation or present a poster. We hope to see you there for a fun and exciting scientific exchange. ■

Kimberley WPEF Conference:
A Rousing Success

Kimberley, British Columbia, a historic mining town, now a charming Bavarian-theme ski and summer destination was the venue for WPEF's eleventh annual conference. Kimberley is set within a beautiful western larch, fir, and aspen forest at the base of the lofty Purcell Range, home to an abundance of high-

mountain habitat including whitebark pine, alpine larch, and tundra-clad peaks.

The conference was preceded Thursday evening (September 13th) by a barbeque at the Nordic Club's lodge on the ski slopes. This event brought out most of the 60 or so conference participants along with many spouses and friends. A BC-produced "Whitebark" microbrew was one highlight. The informal gathering allowed about equal numbers of Canadians and Americans interested in whitebark and limber pine to get acquainted.

The Science and Management Workshop started early Friday morning in the Kimberley Arts Center with a welcome by Randy Moody of the WPEF-Canada organizing committee. The committee managed to keep the conference attendance fee to a minimum ($25) by securing several sponsors including: The Columbia Basin Trust, Teck, Yellow Point Propagation, Keefer Ecological Services, Tipi Mountain Native Plants, and Driftwood Brewing.

Peter Achuff, Scientist Emeritus of Parks Canada, kicked off the presentations by updating us on the status of legal listings for whitebark and limber pine in the Canadian federal system and in the provinces of B.C. and Alberta. The federal legal listing was made in June 2012. Next comes the determination as to whether a recovery strategy is feasible.

University of Montana graduate student Edie Dooley presented her research on mountain pine beetle productivity in whitebark pine. Climatic warming that raised annual temperature two degrees C. or more has allowed beetles to complete their life cycle in one year instead of the customary two-year cycle. As a result, a majority of the mature whitebark pines in the greater Yellowstone Park area have been killed by beetles in recent years. However, an exceptionally early and severe cold wave in October 2009 temporarily interrupted the epidemic.

Joyce Gould of the Alberta Provincial Parks showed us examples of a large, healthy whitebark pine population in the Willmore Wilderness Park north of Jasper National Park, and discussed management issues, including the pressure to use prescribed fire in Willmore to help protect adjacent commercial forests from beetle outbreaks.

Brad Jones of Alberta's Forestry Division discussed strategies and action plans for restoring whitebark and limber pines. Sybille Haeussler and Alana Clason, Bulkley Valley Research Centre, Smithers, B.C., described their efforts, using citizen volunteers to plant whitebark pine seedlings in recent burns in central British Columbia. Michael Murray, with the B.C. Forest Service, explained their blister rust screening program, including propagation, inoculation, repeated observation of resistance, and challenges in nursery culture including rodent depredation.

Charlie Cartwright of the B.C. Tree Improvement Program discussed proposed field testing for rust resistance. He pointed out that tree breeders have recently offered hope for the beleaguered American chestnut by developing a blight-resistant hybrid that is only 1/16th Asian chestnut.

John Schwandt, U.S. Forest Service Whitebark Pine Program leader, presented initial results of direct seeding trials of whitebark pine, which seem to promise good success for regenerating this species at much less expense than raising and outplanting seedlings.

Dave Kolotelo of the B.C. Tree Seed Center showed how X-rays can reveal different levels of viability in whitebark pine seed.

Diana Tomback, University of Colorado at Denver, explained research on the relationship of nutcracker seed dispersal to declines in cone production. Stands with high levels of rust had few nutcracker visits.

Greg DeNitto, U.S. Forest Service pathologist, informed us about the "High Five Pine Data Base" that will soon replace WLIS—the Whitebark and Limber Pine Information System.

Randy Moody of Keefer Ecological Services described whitebark and limber pine restoration projects underway in southeastern B.C.

John King, retired from B.C. Forest Service Research discussed his visit to Russia to examine the Siberian stone pine, a relative of whitebark pine that is highly resistant to blister rust.

Don Pigott of Yellow Point Propagation told us about a whitebark pine natural seed orchard, and demonstrated plastic-mesh cone protectors (see article in this magazine).

Andrew Befus, a graduate student at the University of Calgary, discussed remote sensing approaches for mapping distributions of whitebark and limber pines.

An open forum followed the presentations. Participants raised the issue of different federal and provincial jurisdictions (agencies) that have responsibilities for restoration of whitebark and limber pine. Development of a recovery strategy, required by the listing, offers an opportunity and mechanism for coordination.

A free evening presentation elicited a good turnout of area residents, and introduced them to the whitebark pine ecosystem. Randy Moody set the scene, explaining why whitebark pine is a special tree in this region. Diana Tomback followed with a comprehensive view of the whitebark ecosystem's many values. Michael Murray sketched what is happening locally—his commentary spiked with irrepressible dry humor. Finally, U.S. Geological

Survey biologist Kate Kendall explained why whitebark is so important to black and grizzly bears, including amazing revelations and videos of bears feeding on whitebark pine cones while ignoring an assortment of other foods.

Saturday featured a field trip to 7500-foot Mount Puddingburn, southwest of Kimberley. The group of about 55 thoroughly enjoyed exploring a variety of whitebark pine habitats along the mountains upper slopes. Participants observed and ask questions of experts about bark beetles, blister rust, regeneration, local flora, and forest succession among other topics. Michael Murray showed us a permanent macroplot on an old burn where pole-sized whitebark pine dominate, but are besieged by blister rust. This site serves as an outdoor laboratory to observe natural rust-resistance.

After the whitebark pine field trip, many participants took advantage of mild weather in this beautiful region to vacation for an additional day or longer. A group of 16 made the optional Sunday hike into extensive alpine larch stands in the Purcell Range north of Kimberley, organized by Randy Moody and guided by volunteer Blake Rawson, with ecological commentary by Steve Arno who has studied the larch.

The Kimberley WPEF conference was hailed as a glowing success by participants. Please consider joining us next September in Bozeman, Montana, for next year's fun and informative WPEF conclave—see announcement in this magazine. ■

Earn a Whitebark Pine Calendar

Bryan Donner; <donnermt@yahoo.com>

WPEF depends on members for support to meet our mission of restoration and education concerning whitebark pine ecosystems. As of November 1, the foundation had 188 members. This figure is right at our historic high, achieved in each of the past three years. Although our officers and board serve entirely as volunteers, funds received from membership dues are essential for the Foundation's operations.

As Membership Coordinator for WPEF I am pleased to announce an end-of-the-year award available for recruiting new members. We hope this initiative will push our membership to the 200 level for the first time: **Each current member that recruits a new member at any membership level will be rewarded with the fabulous new WPEF 2013 Calendar**. This calendar contains stunning photography from WPEF members of our high-mountain resource from all over western North America.

Most members recently received an e-mail from me with a New Member Form attached. Please have one or more of your colleagues, family members, or friends use the form to join us. Please contact me if you need a copy of the form. The new member can also join via PayPal on our web site <www.whitebarkfound.org>. Be sure to have the new member you recruit include your name on the form or in the PayPal message. Not only will the WPEF be stronger, but you'll be the envy of your peers with your spectacular and unique 2013 calendar.

These calendars also make great gifts, so recruiting two or more members will allow you one or more to give away.

Reminder: Several of you have not renewed your membership for the coming year. Please contact me if you are unsure if you need to renew. ■

WPEF's Strategic Plan and Foundation Accomplishments

Cyndi Smith and Bob Keane

Some members of the Whitebark Pine Ecosystem Foundation probably wonder just exactly what their organization does. How does the WPEF use membership dollars to conserve whitebark pine? What has the WPEF accomplished, and what does it plan to do in the future? Answering those questions just got a bit easier. The WPEF Board of Directors has now assembled a list of WPEF's accomplishments since its inception in 2001. This detailed list includes providing funds and consultation on many restoration projects, promoting research and management interest in whitebark and other "high five" pines, creation of educational resources, and developing public interpretation displays. We invite you to review this list on our website: http://www.whitebarkfound.org

The Board has also ratified a comprehensive strategic plan for WPEF. This plan reiterates our mission statement and then presents four goals to be completed within the next five years:

GOAL 1: Promote the understanding of, and appreciation for, the ecological value of whitebark pine, and recognition of the accelerating losses of whitebark pine ecosystems rangewide.

GOAL 2: Support research to understand whitebark pine ecosystem processes and functions.

GOAL 3: Counteract the decline of whitebark pine ecosystems by encouraging and supporting protection, conservation and restoration activities in whitebark pine ecosystems.

GOAL 4: Manage the WPEF to increase its efficiency and effectiveness.

Under each goal are a set of objectives that represent guidelines for achieving the goal, and underneath each objective are a set of tasks that we will complete to accomplish each goal. This two page document is now available on our website (http://www.whitebarkfound.org/). We invite you to read it to better understand how the foundation works and what it will be doing in the future. Hopefully, the list of accomplishments and the strategic plan will answer your questions and encourage you to continue and expand your support for conservation of whitebark pine and the other high-elevation five-needle pines. ■

Interview with Michael Murray

Editor: How did you first become interested in studying whitebark pine?

Murray: In the early 1990s, I was pondering whether to continue with studies or pursue my dream as a freestyle disco dance instructor. Based on the tutelage of Dale Thornburgh at Humboldt State University, I developed an interest in high-elevation ecology. About this time, early 1990s, I read the book *Timberline: Mountain and Arctic Forest Frontiers*, and I got hooked on the high country! Soon after enrolling at University of Idaho, the USFS Missoula Fire Lab offered funding for a study of whitebark fire and stand history. I got off to a slow start but Bob Keane, Steve Bunting, and Penny Morgan trusted me to carry through. I spent the next five years immersing myself in whitebark pine ecology, meeting folks with advanced knowledge like Diana Tomback, Ray Hoff, and Wendel Hann, plus working and playing hard in the mountains.

The dissertation research was conducted in the somewhat obscure but majestic West Big Hole Range located on the Continental Divide along the Idaho-Montana border. From this I learned fire occurrence noticeably dropped beginning in the 1870s, likely due to introduction and overgrazing of livestock. During the pre-settlement period, the area was mostly mid-seral stands which were typified by whitebark pine and lodgepole pine. Today the West Big Hole Range exhibits extensive late-seral stands dominated by spruce and fir. Blister rust incidence was quite low – and not a major factor, but has likely increased to over 50% incidence in many stands by now.

Since graduating, I've pursued whitebark pine work with the Oregon Natural Heritage Program, Crater Lake National Park, and now the B.C. Forest Service.

Editor: You've had extensive exposure to whitebark pine ecosystems in (1) a semi-arid region of the Northern Rockies, (2) the southern Cascades, and now (3) interior B.C. What strikes you as some of the most notable differences and similarities among whitebark ecosystems in these regions?

Murray: I've been lucky to live and work at each setting. Maybe this means I'm aging, but hopefully not maturing! There's definitely a difference of scale. The U.S. Northern and Central Rockies have very large agglomerations of whitebark which seem to extend unbroken for miles in many places. Often, these settings are in large roadless areas and designated wilderness. Fire is very evident and direct impacts of development (e.g. roads and ski areas) less noticeable. Whitebark pine populations in the Southern Cascades and Klamath-Siskiyou Region tend to be smaller in extent with signs of fire less obvious, yet still a significant force. The east-west climatic gradient generates impressive diversity in associated flora and blister rust incidence. Stands are much more accessible to casual recreationists. But the lesser explored Klamath-Siskiyou's wilderness offers new discoveries.

When you travel north across the border into Canada, the landscape immediately becomes more rugged. The steepness can limit the extent of pure stands in the West Kootenay region. The climate is remarkably maritime which allows blister rust to prosper. There has been considerable logging in the lower elevations of whitebark's distribution. The East Kootenay region is drier with more rolling highlands that promote larger expressions of whitebark. This region is under increasing pressure from large-scale resort development and mining.

British Columbia is immense and sparsely populated. There's very little collective knowledge of whitebark pine's whereabouts even among forest professionals and naturalists. B.C. remains a true frontier for whitebark pine inquiry and opportunities!

Editor: Although concern about sustainability of whitebark pine ecosystems in Canada was raised many years after similar concerns were voiced in the U.S., Canadians have responded more rapidly with protective listings. Having studied whitebark ecosystems in both countries, what similarities and differences are associated with efforts for whitebark pine restoration in Canada and the U.S.?

Murray: Differences: Provinces seem to have more influence than states over forest lands. In B.C., where the vast majority of Canada's whitebark pine occurs, 95% of the forest is Provincial or "Crown" land. The feds manage only 1% of forests. The B.C. Forest Service in not nearly as multi-disciplined as U.S. Forest Service, and there's only a handful of government employees with any whitebark pine expertise. There's actually no B.C. government-sponsored restoration effort yet, while Alberta is drafting a recovery strategy. Thankfully, Parks Canada has implemented restoration projects on federal land. Meanwhile, the vast majority of whitebark pine acreage (located on B.C. Crown land) remains unaddressed. Having planted thousands of rust-resistant trees, the U.S. is far ahead of Canada.

Similarities: WPEF is making progress in both countries by raising awareness and providing expertise to governments.

Editor: What's your vision for the WPEF?

Murray: Our 180+ members are incredibly dedicated and talented people. We've raised awareness, partnered with land managers and American Forests, networked, and assisted students. On the flip side, whitebark pine continues to fade, and I fear that in many locations it has become insignificant for sustaining wildlife. We won't succeed without good relationships with government at multiple scales--local to national. We are poised to play a meaningful role as Endangered Species listings amplify attention. We need to strengthen our ties with forest health professionals, geneticists, and nurseries. Let's merge annual workshops with other organizations (e.g. SER, TWS, NAA) and consider re-organizing to having both a science advisory Board and an executive Board to better raise funds.

Editor: What are you up to now?

Murray: As I mentioned, B.C. is a vast province where knowledge of whitebark pine is scant. There are many opportunities. I'm coordinating blister rust screening. Working with WPEF, the B.C. Forest Service's Kalamalka Nursery, the USFS Dorena Nursery, and others. We have 40 families, that's 40 trees we've collected from. I'm thinking of doing some rust hazard modeling for the Kootenays this winter. Applying for stand enhancement funding. Also I'm involved in discussions to form a B.C. Whitebark Pine Recovery Team in accordance with federal listing. Along with the other tree species I focus on for my job, I keep quite busy. Sadly, I've had little time to continue my disco lifestyle, but folks can hear me host "Flashback Seventies" every Tuesday evening at www.CJLY.org! ■

WPEF Awards Student Research Grant

A call for proposals for the first ever WPEF student research grant was released in the Spring/Summer issue of *Nutcracker Notes*. We were excited to receive eight proposals, all of which will improve our understanding of five-needled pine ecology and management when they are completed. The proposals were reviewed by board members Edie Dooley, Bryan Donner and Cyndi Smith. Signe Leirfallom, a Master's Degree candidate in forestry at the University of Montana, was awarded the $1,000 grant for 2012. Following is a short description of her project:

Effects of seed source mortality on whitebark pine regeneration after stand-replacing fire

Introduction

Whitebark pine (*Pinus albicaulis*) is declining across most of its range in North America due to the combined effects of mountain pine beetle, fire exclusion policies, and the exotic pathogen *Cronartium ribicola*, which causes the disease white pine blister rust. In the northern Rocky Mountains of the United States, whitebark pine cone crops have been reduced to such an extent in some areas that the whitebark pine's regeneration potential is compromised. This is especially true after large, stand-replacement burns where, historically, whitebark pine was the only species able to colonize these extensive areas due to the long seed dispersal distance of the Clark's nutcracker. The objective of this study is to estimate the effect of mountain pine beetle kill and white pine blister rust mortality on seed dispersal and subsequent regeneration in large, high-elevation burns. We want to assess whether whitebark pine regeneration is occurring within an historical time frame and at sufficient densities needed for adequate restocking.

Study Objectives

The following sub-objectives, or tasks, will help complete the primary objective:

1. Determine the level and sources of mortality in whitebark pine within unburned stands that

provide the seed sources to large burns

2. Determine the level of regeneration density in the adjacent large burned area
3. Determine microsite influences on this regeneration potential by sampling (a) time since fire, (b) burn aspect and elevation, (c) type of microsite, (d) other variables identified in analysis
4. Examine health of regeneration with respect to blister rust infection and other damaging factors

Methods

We will select several large areas that burned between 1980 and 1995, in the elevational range of whitebark pine, that have an adjacent unburned mature forest stand that is a significant seed source for whitebark pine. Site selection will be accomplished by GIS analysis and communication with local district personnel. Once sites are identified, we will sample the seed source stand using FIREMON protocols to determine the density and health of seed-producing whitebark pine and the extent of their mortality from rust, beetles, and past fires. We will then sample tree regeneration densities within smaller seedling plots established in a grid pattern within the burn, and for whitebark pine seedlings, we will sample additional variables that describe the microsite and seedling size, age, and health. We will then attempt to examine the relationship between whitebark pine mortality level and/or health in the unburned stand and level of whitebark pine regeneration in the burn using parametric and non-parametric statistical analysis. For this relationship, we will attempt to determine the lower limit of healthy, seed-producing whitebark pine that is needed in a seed source stand to provide for successful whitebark pine seedling regeneration in burned areas. We will also analyze variables such as aspect, slope, elevation, ground cover, and presence of ground features that might influence whitebark pine regeneration dynamics within burns.

Benefit to Management

Information collected from this study should provide land managers with critical information needed to restore whitebark pine ecosystems. Currently, managers are relying mostly on natural regeneration to maintain whitebark pine communities, but recent research indicates that planting seedlings is essential for implementing effective restoration treatments in areas with high whitebark pine mortality. Managers need a measure of forest health, such as mortality, above which bird dispersal will not suffice as the primary regeneration vehicle and planting is indicated. This study is designed to quantify these measures and thresholds of regeneration dynamics. ■

List Servers Provide Updates on Whitebark Pine

To facilitate communication between people and groups on several topics Richard Sniezko at the USFS Dorena Nursery has set up moderated mailing lists/listservers for several topics that are international and interdisciplinary in scope: These include:

1. White Pine Blister Rust (Cronartium ribicola) - particularly related to disease resistance.
2. Pest Resistance in Trees (Insect or pathogen resistance)
3. Whitebark pine in the Pacific Northwest (status of the species, blister rust impacts, current activities)
4. Whitebark pine (and other 'white' pines, particularly high elevation 5-needle pines susceptible to blister rust)

Visit <www.fs.usda.gov/goto/r6/dorena> to connect to these list servers. ■

Announcing International Conference: June 2014 in Colorado

A joint international meeting of three groups: IUFRO* 2.02.15 (Breeding and Genetic Resources of Five-Needle Pines), IUFRO 7.02.05** (Rusts of Forest Trees) and Strobusphere is being scheduled for June*** 2014 in Colorado (USA). This will be the first time these three groups have met together to share research in genetics-pathology of five-needle pines. The conference will feature advances in gene conservation, genomics, rust resistance, evolutionary dynamics and other related topics. Visit the websites below for future updates on this meeting, or contact Richard Sniezko (rsniezko@fs.fed.us), Anna Schoettle (aschoettle@fs.fed.us), Richard Hamelin (rhamelin@NRCan.gc.ca) or David Neale (dbneale@ucdavis.edu) . We are building a mailing list for this meeting, if interested please send your name and email address to Richard Sniezko (rsniezko@fs.fed.us).

2.02.15 – Breeding and genetic resources of five-needle pines

http://www.iufro.org/science/divisions/division-2/20000/20200/20215/

Our Working Party on Breeding and Genetic Resources of Five-Needle Pines is concerned with research cooperation and exchange of information on

Continued on page 10

2013 Nominations for Whitebark Pine Ecosystem Foundation Board

Our bylaws dictate that elections are to be held every year for various positions – this way there is always a rotation of experienced Board Members and Executive Committee officers and we would never face a complete turnover of officers and the chaos that could ensue. Please consider running for one of these positions!

Board members and officers commit to working collectively to advance the business of the WPEF and the conservation and restoration of high elevation pines. This includes attending two board meetings per year, one of which is usually in March or April in Missoula, MT, and the second is in conjunction with the annual WPEF science meeting and field trip in mid-to-late September somewhere within the range of whitebark pine. To find out more about the duties of these positions, please refer to the back of this form, and/or consult the WPEF Executive Handbook on the website www.whitebarkfound.org.

Diana F. Tomback, Ph.D.
Director

Nomination Form – Whitebark Pine Ecosystem Foundation

Nominations are being sought for the following four (4) positions, to begin serving on the Board of Directors in September, 2013. All positions are for a 3-year term:

- Director
- Secretary
- Board Member
- Board Member

RULES:

- All board members can serve up to 3 terms consecutively [Bylaw E(h), E(i) and F(a)].
- All nominees must be members of the WPEF in good standing [Bylaw F(b)(iv)].
- Any nomination must be made by 2 members in good standing [Bylaw F(b)(i)]; signatures can be on one form, or on separate forms.
- Any nomination must be validated by the signature of the nominee [Bylaw F(b)(i)]; this signature can be on the same form as a nominator, or on a separate form.
- **Only one nomination per form**. If you need more forms, please copy this one, or download another one from our website <www.whitebarkfound.org>.
- Nominations may be sent by mail [Box 17943, Missoula, MT, 59808], E-mail hsmith04@fs.fed.us or fax (406-329-4877), and must be postmarked/dated no later than **01 Feb 2013.**

We, the undersigned, nominate _____ for the position of DIRECTOR ___, SECRETARY ___, BOARD MEMBER ___ [please check the one that applies].

Nominator #1: _____ _____ _____
Signature *Print Name* *E-mail address*

Nominator #2: _____ _____ _____
Signature *Print Name* *E-mail address*

Nominee: _____ _____ _____
Signature *Print Name* *E-mail address*

Continued on page 20

all aspects of genetic research on the five-needle pines. This includes provenance and progeny testing, gene conservation, landscape genomics, breeding, species hybridization, clonal propagation and testing, tissue or cell culture, molecular genetics, and the genetics of host-pathogen interactions, as well as ecology, evolutionary dynamics and management of these species. Increasingly though we are using this knowledge to address issues related to climate change, land use pressure and conservation

7.02.05 – Rusts of forest trees

http://www.iufro.org/science/divisions/division-7/70000/70200/70205/

Our Working Party aims to bring together scientists and investigators working on tree rusts. Our goal is to foster scientific discussion and exchanges relating to tree rust epidemiology, biology, host-pathogen interactions, resistance, control and management, and genomics. Our working group meets approximately once every 4 years in locations in Europe, North America or Asia. We usually meet in locations that allow us to discuss our scientific findings and have field trips in a friendly and relaxed environment which is conducive to exchanges and debates. We want to place a strong emphasis on participation of young investigators and students, as these meetings provide unique experiences to meet and exchange with the related community.

Strobusphere

http://dendrome.ucdavis.edu/strobusphere/

In North America, a collaborative effort among researchers has begun, starting with a multi-national ***White Pine Genomic Resource Workshop*** held on October 22-23, 2008 at the Dorena Genetic Resource Center in Cottage Grove, OR. The objective of this workshop was to discover and identify research objectives, strengths, scope and resources among the various working agencies. This collaborative effort is designed as a foundation to build wider scientific participation with a scope that spans molecular to landscape models, from host to pathogens and alternative hosts. The Strobusphere working group arose from this 2008 workshop. A notable work in progress: the sugar pine genome sequence is slated for completion in 2013 by PineRefSeq project (http://pinegenome.org/pinerefseq/). The sugar pine genome will be mostly finished and released to the public before the meeting in June 2014.

*IUFRO: Intenational Union of Forest Research Organizationsn - "the" global network for forest science cooperation

**7.02.05 Rust of Forest Trees group will also have some separate concurrent sessions relating to rusts in other tree species.

***The dates of the June meeting are tba (be will be the 2nd or 3rd week of June 2014). ■

Election News and Call for Nominations for Board of Directors

Cyndi Smith, WPEF Associate Director

At the Fall 2012, Board of Directors (BOD) meeting in Kimberley, British Columbia, held in conjunction with WPEF-Canada, we welcomed new general board members Liz Davy and Gerry Gray. Both were elected by the existing BOD, as per Bylaw E(f).

Liz brings many years of whitebark pine experience to the BOD, having been an active member of the Greater Yellowstone Whitebark Pine Monitoring Working Group, a sub-committee of the Greater Yellowstone Coordinating Committee. She also brings great experience with other non-profit boards.

Gerry is senior vice president of American Forests, and is that organization's principal expert and educator on conservation issues and public policy, and has a background in forestry. The WPEF and American Forests signed a letter of agreement in 2011 to collaborate on education and outreach efforts in support of whitebark pine.

Call for Nominations (see form on page 9)

WPEF is now seeking nominations to fill four positions: director, secretary, and two general board members. These new members would start serving on the BOD in September, 2013. A nomination form is printed in this magazine and is also available on the Foundation's website … www.whitebarkfound.org, along with a list of responsibilities for each of the positions. **Nominations close on 1 February 2013**. Please consider running for one of these positions, or nominating someone else. All nominees must be (or become) members of WPEF. Your active participation is critical to keeping the Foundation relevant to the general membership.

If you have questions about any of the positions or the nomination process, please contact me at cyndi.smith9@gmail.com. ■

Whitebark Pine Listed as Endangered in Canada

Peter Achuff, Botanist Emeritus, Parks Canada

On June 20, 2012, the Government of Canada listed whitebark pine as Endangered in Canada, under Schedule I of the *Species at Risk Act* (SARA). This has been a lengthy process and highly anticipated following its status assessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April 2010. SARA listing immediately applies on federal lands, prohibiting the harm, killing, collecting, buying, selling or possession of the species. Under a federal-provincial/territorial accord, provinces and territories have agreed to provide "effective protection and enforcement" within their jurisdictions for species legally listed under SARA. Whitebark pine occurs in Canada in only two provinces: Alberta and British Columbia. In Alberta, whitebark pine has been listed under the *Alberta Wildlife Act*. However, there are no regulations under the Act that provide protection for plants. Policy and planning guidelines are currently being used to conserve whitebark pine and its habitat. In British Columbia, which contains about 75% of the Canadian population, the species is not legally listed. Policy and planning guidelines have been issued but the effectiveness of these is not clear and it appears that some loss to harvesting is occurring.

SARA requires that a Recovery Strategy for an Endangered species be completed within one year of listing. The Recovery Strategy will contain a recovery goal stated as objectives for population size and geographic distribution based on the threats facing the species (white pine blister rust, habitat change, mountain pine beetle, climate change) and identify the critical habitat needed to ensure survival and recovery of the species. It appears that the one-year timeline will not be met due to lack of resources.

Restoration activities will likely include seed and gene banking, prescribed fire for habitat restoration, planting rust-resistant seedlings and research on genetic resistance and responses to climate change. Such activities are permitted under SARA where they benefit or enhance the survival and recovery of the species.

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Grafting Whitebark Pine

David Foushee, dfoushee@fs.fed.us Tree Improvement Horticulturist
Idaho Panhandle N.F., Coeur d'Alene Nursery

Grafting is the preferred technique for propagating conifers such as Western white pine, ponderosa pine, Western larch, Douglas-fir, lodgepole pine, and most recently Whitebark pine. It is commonly used to make multiple copies of genetically elite trees or plus-trees for seed orchards, clone banks, and pollen banks.

Healthy branch tips called scion are normally collected from the upper third of the tree crown in February or March while the plus-tree is still dormant. Scion is stored at 34°F and two weeks prior to grafting, healthy, dormant rootstock are moved into a greenhouse heated to 68°F and with grow lights set to provide extended day length. This is like pushing the fast forward button for the seasons and causes the rootstock to come out of dormancy and begin to grow so that grafts heal more quickly and water and nutrients are translocated across the graft union as growth starts. The Coeur d'Alene Nursery uses a top cleft graft which involves cutting off the terminal stem of the rootstock and inserting a wedge shaped piece of scion into a vertical cut in the stem. Rubber budding strips are wrapped around the graft union to hold the cut faces of the scion and rootstock together with even pressure. Finally, a strip of stretchable wax film is wrapped several times over the union to prevent desiccation. For whitebark pine, buds on the scion begin to swell and growth becomes noticeable in about 6-8 weeks.

Dormant February-March scion collection and

grafting at the Coeur d'Alene Nursery has yielded an average of 75% to 95% viable grafts per total rootstock grafted for Western white pine, ponderosa pine, Western larch, Douglas-fir, and lodgepole pine. Health and vigor of the scion material/rootstock and grafter skill definitely have an effect on graft survival. Whitebark pine was first grafted at the Nursery in 2008 using the dormant Feb/Mar. scion collection/grafting model that had worked so well with all of our other species. Overall first year whitebark graft survival was 76% but the two most important things learned during those first two years of grafting whitebark were: (1) While traveling to plus-trees of lower elevation species to collect dormant scion in late winter can be challenging, the remote, alpine locations of whitebark plus-trees can present the ultimate challenge, similar to a Mount Everest expedition. This has both safety and cost implications. Also, (2) Whitebark grafts do not like to be held for more than one year in the tall 3/4 gallon pots used at the Nursery.

Because many of the grafts that first year were small in comparison to faster growing species, it was decided to hold the grafts for a second year of growth at the Nursery prior to planting them in seed orchards. By the time these grafts were shipped to the seed orchard representing the Inland Northwest (INLA) Seed Zone on the Lolo National Forest, survival had dropped from 76% to 46%. Some of this mortality can be attributed to root pathogens and the root bound condition of the 5 to 7 year old rootstock, but since then we have also observed stressed whitebark grafts on younger more vigorous rootstock during extended periods of late summer heat when outdoor ambient temperatures are above 90°F and greenhouse temperatures approach 80°F even with cooling and ventilation.

Based on our experiences at the Coeur d'Alene Nursery, and where these grafts are planted in high elevation seed orchards, regardless of how small and wimpy a whitebark pine graft appears in the greenhouse, survival is much better when they are planted in the early fall in alpine soils with the full suite of native flora and adequate moisture and microsite shading of root collars as opposed to holding them longer in the "intensive care unit" at the Nursery in an effort to increase graft size and vigor.

In response to concerns about the safety and cost of collecting scion from whitebark plus-trees in late winter, in 2009 a comparison was made between the usual model of scion collected and grafted in late winter and scion collected in mid-November and stored frozen at 0°F until grafted in late winter. First year survival of the 60 grafts made with late winter collected scion was 68% and survival of the 90 grafts made with mid-November collected scion was 74%. Now fall scion collection and late winter grafting has become the new model for whitebark pine grafting at the Coeur d'Alene Nursery in support of the Whitebark Pine Genetic Restoration Program for the Intermountain West.

Scion collection across the 4 whitebark seed zones in Regions 1, 2, and 4 is now a multi-agency effort. Data from early blister rust screening of seedling progeny has been used to rank plus-trees according to rust resistance and scion material has been collected from 57 of those trees and grafted onto rootstock over the past 4 years. Most of these grafts have been planted at 3 seed orchards on the Lolo, Clearwater, and Lewis-Clark National Forests. These orchards represent respectively 3 seed zones: Inland Northwest (INLA), Bitterroots/Idaho Plateau (BTIP), and Central Montana (CLMT). In 2013, grafts will begin to be planted at a fourth orchard on the Gallatin National Forest, representing the Greater Yellowstone/Grand Teton (GYGT) seed zone. In the fall of 2011 and late winter of 2012, whitebark pine scion collection and grafting was increased to not only propagate grafts from rust resistant plus-trees for seed orchards, but also to preserve genetic diversity before further losses across the landscape due to blister rust, mountain pine beetle, and fire.

Field personnel were instructed to wait as late in the fall as possible before collecting scion so that plus-trees were as dormant as possible but access to the trees was still relatively easy prior to significant snowfall. Scion was collected in 2011 from 27 plus-trees as early as Oct. 21 and as late as Dec. 5. From Feb. 27 to Mar. 6, 2012, 844 grafts were produced and an inventory taken at the end of the growing season showed an overall survival rate of 81%.

In September 2011, a wildfire in the Puzzle Hills area of the Flathead National Forest was threatening whitebark pine plus-trees. Cones had been caged earlier that year on 6 plus-trees in the area so tree climbers were mobilized quickly on September 13 to harvest cones from those trees before the fire reached them. Not knowing if these trees would survive the approaching fire, climbers were instructed to collect green, semi-succulent scion in an effort to preserve these trees with grafts. Scion was delivered

to the Nursery and stored in a cooler at 34°F until it was grafted on Sept. 28. Results of this opportunistic non-dormant or "hot" grafting trial are shown in Table 1 and surviving grafts are shown in Figure 1 (on back cover).

Table 1. Whitebark Pine Non-Dormant Scion Grafted 2 Weeks After Collection.

Area	Tree	Zone	Forest	Scion Collected	Scion Grafted	# Grafted	Live Grafts 10/9/2012	% Survival
Puzzle Hills	6171	INLA	FLHD	9/13/2011	9/28/2011	10	3	30%
Puzzle Hills	6172	INLA	FLHD	9/13/2011	9/28/2011	10	1	10%
Puzzle Hills	6173	INLA	FLHD	9/13/2011	9/28/2011	10	4	40%
Puzzle Hills	6174	INLA	FLHD	9/13/2011	9/28/2011	10	4	40%
Puzzle Hills	6972	INLA	FLHD	9/13/2011	9/28/2011	10	4	40%
Puzzle Hills	6175	INLA	FLHD	9/13/2011	9/28/2011	10	8	80%
Total						60	24	40%

While graft survival of green scion on green rootstock was only half as good as more dormant scion grafted to dormant rootstock, this small trial does show that viable grafts can be produced and cost savings would be tremendous if both cones and scion could be collected in one trip to remote trees.

In summary, the late winter dormant scion-dormant rootstock model of lower elevation conifers has been modified for propagation of whitebark pine. Scion collected as late in the fall as possible but prior to deep snowpacks is safer, less costly and production of viable grafts per rootstock grafted is similar to the late winter model. Grafting of non-dormant scion to non-dormant rootstock produced fewer viable grafts but this approach is an attractive option when both cones and scion need to be collected from the same tree. Since cones are usually caged, delaying the collection until later in the fall would provide more dormant scion and possibly better graft survival without jeopardizing the seed harvest. ■

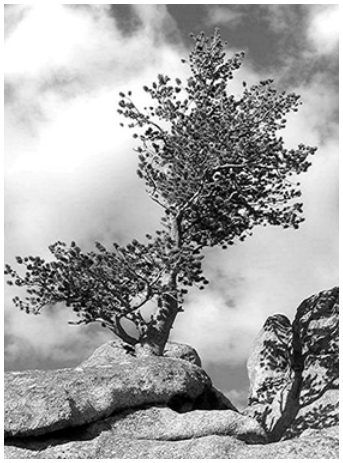

Photo by Erin Borgman

Limber Pine Conservation in Rocky Mountain National Park

Jeff Connor[1], Anna Schoettle[2], Kelly Burns[3], Erin Borgman[4]

1 USDI Rocky Mountain National Park, Estes Park, CO

2 USDA Forest Service Rocky Mountain Research Station, Fort Collins, CO

3 USDA Forest Service Forest Health Protection, Lakewood, CO

4 Graduate Degree Program in Ecology, Colorado State University, Fort Collins, CO

Limber pines are one of the most picturesque trees in Rocky Mountain National Park (RMNP). Growing in some of the park's most exposed rocky sites, the trees' gnarled trunks give testimony to fierce winds that buffet them in winter. Limber pines live to great ages, with some in the park exceeding 1,000 years. An especially photogenic stand of ancient trees defies the wind at Knife's Edge along Trail Ridge Road, and a remarkable old giant stands sentinel on the shore of Lake Haiyaha. Although the species occurs in small stands dominating only about 2,700 acres of the park, limber pine is an ecologically important tree and is the only white pine in the park. Clark's nutcrackers feed on and cache the seeds in the forest floor and the seeds are an important source of nutrition for bears and pine squirrels. The trees are also vital for watershed protection.

Limber pine within RMNP is currently declining due to an outbreak of mountain pine beetle (MPB) that started in 2003 in the lodgepole and expanded into limber pine in 2007. All large diameter limber pine are threatened by mountain pine beetle, and sadly most of the notable old giant limber pines along Knife's Edge are now dead. Also, in 2010 white pine blister rust (WPBR) was confirmed for the first time in the park. Past research has shown that limber pine is highly

susceptible to this disease, and as it becomes more prevalent we can expect high mortality of trees of all sizes.

Due to the combined effect of MPB with the threat of WPBR, the park considers limber pine a species of management concern. The joint impacts of MPB caused mortality on reproductive limber pines and WPBR mortality on susceptible young seedlings has the potential to severely compromise ecosystem resiliency and even could lead to the extirpation of limber pine within the park. Due to lessons learned from whitebark pine in the Northern Rockies, in 2008 the park in collaboration with the US Forest Service decided to take an adaptive proactive approach to managing limber pine (*see* Schoettle and Sniezko 2007, Burns et al. 2008, Keane and Schoettle 2011).

Seventeen limber pine sites in RMNP and 10 sites just outside the park serve as the sampling framework for the limber pine conservation project. Along the Front Range of northern Colorado, limber pine grows from the grassland treeline (lower timberline) up to the alpine treeline. To capture the full habitat diversity of the species, limber pine study areas were stratified by elevation, ranging from 8,300 to 11,300 ft. Almost all of the park sites are within designated wilderness and have been identified as resources at risk. For instance, when the Fern Lake wildland fire started within the park this fall, the incident command team was provided the location information of these areas so they can be protected if possible. Additionally, during fuels reduction operations, guidelines are provided to thinning crews to avoid cutting limber pine.

The focus of the limber pine project to date has been to protect the limber pine in the short-term and gather scientific data to develop a management strategy to sustain limber pine for the long-term. The efforts include: (1) *in situ* protection and *ex situ* conservation of limber pine and (2) research on the frequency of resistance to blister rust, regeneration dynamics and genecology for limber pine in and near the park. Some details of the on-going project are described below.

In situ protection of limber pine from MPB attack

Over 275 individual limber pines have been treated with verbenone at the 17 limber pine sites in the park since 2008. The trees are tagged and geo-referenced for relocation. Verbenone pouches are placed before and during beetle flight each summer. At the time of site establishment in 2008 approximately 40% of the sites had active MPB activity while 5 years later almost all sites had some level of activity. As of 2009, the proportion of non-treated limber pine being infested by MPB on these sites was similar to the proportion of other MPB-host trees being infested (Klutsch et al. 2011). Over the last five years, 15% of the verbenone-treated trees have experienced some MPB activity, ranging from unsuccessful pitch outs to mass attacks. Approximately 34% of treated trees within the stands with beetle activity have not experienced any fading of the crown to date. Only 5 trees treated with verbenone have died from MPB attack (1.8%). MPB pressure peaked and appears to be declining in limber pine in this area. The verbenone treatments are scheduled to continue in 2013.

Table 1

Mountain pine beetle activity summarized by year for limber pine trees treated with verbenone at 17 sites in RMNP. In 2008, 130 limber pine trees were treated and 277 trees were treated each year thereafter.

Year	Number of trees with beetle activity	Number of trees with *first-time* beetle activity	Number of trees with *repeat* beetle activity	Mortality
2008	8	8	-	-
2009	18	14	4	2
2010	21	11	10	1
2011	6	5	1	1
2012	9	3	6	1

E*x situ* seed conservation of limber pine

Target seed collections from each of 10 seed trees per limber pine site (a subset of the trees protected with verbenone) have been attempted since 2008. Cone production and seed yield varied among sites and years. Over 200 individual-tree seed collections have been made from the 17 limber pine sites in the park; bulk seed collections have also been made from each site. The additional 10 sites just outside the park on National Forest lands were also sampled to provide a more regional collection for a total of over 300 individual-tree and 26 bulk lot seed collections to date across all 27 study sites. The seeds are being used for research (see below) and are archived for gene conservation and future restoration efforts.

White pine blister rust resistance research

Paramount to the sustainability of limber pine populations in the presence of WPBR is genetic resistance to the disease. Estimates of the frequency of resistance in the populations provide baseline information from which to predict potential outcomes of WPBR invasion. To define the frequency of resistance in the Park and surrounding areas and to explore the geographic variation in those frequencies, rust resistance testing of progeny from 179 seed trees (121 from RMNP) and 26 population collections are

underway (see Schoettle et al. 2011). Select trees of high value to park visitors were also included in the testing. Early results indicate that resistance to WPBR occurs in RMNP limber pine populations and that the frequencies of resistance in the park are similar to those found in the greater northern Colorado landscape.

Understanding regeneration dynamics

Maintaining successful regeneration into the future will be critical for the recovery of limber pine after MPB and to sustain these populations after WPBR becomes more prevalent (Schoettle and Sniezko 2007). The regeneration dynamics of the species in different habitats is being explored across the 27 study sites. More intensive research in the Ouzel Fire of 1978 demonstrates that ample successful regeneration of limber pine in the park is possible (Coop and Schoettle 2009). The recent Cow Creek Fire (2010) and Fern Lake Fire (2012) burned habitat near several of our sites and will likely provide valuable regeneration opportunities for limber pine.

Genecology studies of limber pine

While the habitats differ among the study sites with elevation, it is not known to what extent the limber pine of RMNP are locally adapted to those habitats. A common garden study underway to test for genetic differentiation among sites will provide information to guide seed-transfer recommendations to avoid outplanting failure due to maladaptation.

In conclusion, over the coming year this information will be integrated to provide the science foundation to develop interventions to promote self sustaining limber pine ecosystems that have resilience to disturbances and genetic resistance to WPBR. The park is fully taking advantage of the opportunity to protect, conserve and learn from the limber pine ecosystems before they are impacted by WPBR to improve efforts to sustain these valued ecosystems into the future as they continue to face new challenges. In 2013, park staff working with the US Forest Service will develop a long-term sustainability plan for preserving limber pine in a rapidly changing environment due to climatic warming.

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Mapping Whitebark Pine at Crater Lake National Park

Matt Noone, Institute for Natural Resources, Portland State University
Michael Murray, B.C. Forest Service and Ecologist Emeritus at Crater Lake NP

Introduction

For future management decision support, it is necessary to first identify the baseline distribution of whitebark pine. Prior efforts to map whitebark pine at Crater Lake National Park were at a resolution too coarse to effectively measure changes in whitebark pine distribution and were unable to differentiate mountain hemlock (*Tsuga mertensiana*) from whitebark pine. Therefore, a collaborative project between the Institute for Natural Resources (INR) at Portland State

University, Portland, Oregon, and the National Park Service (NPS) was undertaken between 2008 and 2012 to assess the distribution of whitebark pine (*Pinus albicaulis*) at Crater Lake National Park. Mapping methods included distribution modeling, remote sensing, GIS and expert knowledge.

Methods

A Random Forest (RF) model was run to predict the distribution of whitebark occurrences throughout the park. This relied on digitized polygons from field observations as training data. RF uses a Classification and Regression Tree (CART; Breiman et al 1984) methodology to combine multiple replicate tree classifiers, each generated from a randomly selected subsample of the original predictor dataset. RF has the capability to utilize both categorical and continuous predictor variables and to incorporate complex relationships between variables (Garzon et al. 2006, Phillips et al. 2006). The RF regression model produced a continuous probability estimate of whitebark pine occurrence at 5 meter pixel resolution. This whitebark pine prediction raster was then grouped into 5 classes to ease interpretation. The classes are:

1. No whitebark pine;
2. Trace occurrences only;
3. Interspersed, if present a minor component;
4. A codominant species; or
5. The dominant tree.

For use in the modeling, one meter resolution LiDAR (Light Detection and Ranging) data flown in 2010 was obtained from the NPS. The LiDAR base elevation layer and the highest hit layer were differenced, resulting in a vegetation height layer. Both the vegetation heights and elevation were used as predictor variables. 1 meter resolution, 4 band National Agricultural Imagery Program (NAIP) imagery from 2011 was obtained and used as a predictor variable (Table 1) as well.

Positive whitebark pine training samples were created from random points located within the digitized whitebark pine training polygons, and predictor variable values were sampled. Any training point with a LiDAR height of less than 4 feet was deemed a negative occurrence. If the point landed on vegetation with a height over 65 feet it was also deemed as a negative occurrence. Additional negative occurrence points were visually interpreted and manually placed in areas which were clearly not whitebark pine, such as lower elevation tall forests, pumice areas or water.

A field crew from INR spent 3 days at Crater Lake ground truthing the map, evaluating it for commission and omission errors. Notes were taken and drawn on the initial predictive map for later revisions back in the lab. Additionally, GPS points were taken where occurrences of whitebark pine were not mapped or incorrectly mapped. These points were then added to the existing positive occurrence and negative occurrence training data; so the RF model could be further refined.Once the predictive model was refined, the map was submitted for review by NPS staff. Comments and recommendations were then incorporated into the final map. Recommendations included the addition of several whitebark pine populations throughout the park and changing the probability of occurrence in particular areas based upon elevation. The final edits and recommendations were manually fixed.

Table 1. Predictor variables used in RF model:

LiDAR Vegetation height
LiDAR Elevation
NAIP red band
NAIP green band
NAIP blue band
NAIP infrared band
NAIP Normalized Difference Vegetation Index

Results

Four whitebark pine prevalence classes were mapped, trace, interspersed, codominant, and dominant. (See map on front cover.) The trace class typically represents areas that are generally dominated by lodgepole pine (*Pinus contorta*) with scattered whitebark pines, these areas are particularly present on the east side of the park at elevations between 6,600 and 6,800 feet. An increase in elevation represents the interspersed class that has a whitebark pine presence but a greater prevalence in the canopy of mountain hemlock (*Tsuga mertensiana*) and shasta red fir (*Abies magnifica* var. *shastensis*) . Increasing in elevation further, with higher winds and lower temperatures, is the codominant class represented only by whitebark pine and mountain hemlock. Depending upon geographic location in the park, whitebark pine dominates as low as 6,900 feet elevation; this class is represented by the dominant class. Table 2 contains a summary of the acreage present of each of the whitebark pine classes in the park.

Table 2. Predicted acreage of whitebark pine classes

Class	Acres
Trace	1,699
Interspersed	1,387
Codominant	1,181
Dominant	950
Total Acres	5,217

Summary

Whitebark pine is a valuable species to wildlife, associated plants, soil stabilization, park visitors, and hydrology. Prior to the current mapping effort very little information about whitebark pine communities throughout the park had been digitally documented. Our mapping effort provides new and useful baseline information. Given the perils whitebark pine is facing, it is essential to document such conditions to aid whitebark pine restoration or at least reduce its future losses.

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Whitebark Restoration and the Mining Industry: Potential for collaboration?

Moody, R.[1], Clason, A.J.[2,3]

1. Keefer Ecological Services Ltd., 3816 Highland Road, Cranbrook B.C. V1C 6X7
2. Natural Resources and Environmental Studies Institute, University of Northern British Columbia, 2018 Administration Building, 3333 University Way, Prince George, BC Canada, V2N 4Z9
3. Bulkley Valley Research Centre, PO Box 4274, Smithers BC, V0J 2N0

Industrial development in whitebark pine habitats is a cause for concern due to the potential for increased damage or mortality to a species with rising mortality rates from white pine blister rust and mountain pine beetle. Even when an industrial development has the potential for minimal impact, the cumulative effects of the development along with the above mortality agents must be considered. However, given the right industrial partner, there is potential to develop a long-term restoration strategy designed to reduce the impacts of industry, while also enhancing local whitebark pine populations outside of the development area. These potential collaborations between whitebark pine restoration ecologists and industry should be a source of cautious optimism in light of industrial development in whitebark pine habitats.

In 2011, we began working at the proposed Blackwater mine owned by New Gold Inc, located on Mt. Davidson in central British Columbia. This collaboration could become an example of how industry can engage with whitebark pine restoration practitioners to potentially yield a positive outcome for whitebark pine during and after mining. This proposed gold mine sits on an isolated mountain on the western edge of the Nechako plateau; approximately 40km north of the nearest pockets of whitebark pine in Itcha Ilgachez Provincial Park , and 70km from the nearest sizeable populations of whitebark, in Tweedsmuir Provincial Park. Mt. Davidson is 1850m in elevation, with whitebark pine beginning to appear at about 1575m on the north-facing slope, in the vicinity of the proposed open pit. Whitebark pine on Mt. Davidson is found in a mix of stand types: closed forests comprised of old trees with little whitebark pine regeneration; open parkland with abundant regeneration, saplings and mature trees; and abundant whitebark pine in the vicinity of the treeline. These stands have been affected by blister rust and mountain pine beetle; the treeline and subalpine parkland identified as a potential mitigation area has a rust infection rate of 36%. The combination of mortality due to blister rust and proposed industrial development on Mt. Davidson suggests the need for preventative measures to mitigate impacts of mining by planning for future recovery of this isolated population of whitebark pine.

As this mine is moving through the environmental assessment process and is not yet operational, we are able to propose management strategies for whitebark pine at the exploration phase that extend right to mine closure. To mitigate exploration activities, our work has focused on reducing impacts on live whitebark pine seed trees and conducting transplanting trials. Given the relative isolation of the population on Mt. Davidson, local pollen and seed sources may be very important to maintain the population outside of the mine footprint. We have marked individual healthy trees for retention that workers are to avoid during clearing activities. For the transplant trials, 20 seedlings of varying sizes were excavated by hand to test their ability to survive transplanting. Given the time it takes for whitebark pine trees to reach maturity and bear cones, we hope these transplants will produce cones sooner than those from our seedling production.

In advance of full mine development and as a component of long-term planning, we will also collect seed from the healthiest trees in the impacted population for use in seedling production, on and off-site restoration trials, field-based rust screening, and

possibly more intensive rust screening. This collection has been delayed until 2013 due to a lack of seed in 2012 across northern populations of whitebark pine. New Gold is already planning future site reclamation by conducting research trials around the use of whitebark pine seedlings in restoration, and it plans to bank seed for use in future reclamation efforts.

Collaborating with mining companies can provide benefits to whitebark pine restoration capacity in terms of financial contributions. Additional benefits may occur when a company is willing to increase the knowledge base through supporting restoration research, as is the case with New Gold. In this case there may be positive outcomes for whitebark pine well beyond the area affected by a given mine. If the Blackwater mine project is constructed, during its lifetime it could support long-term blister rust screening and restoration trials in addition to the work required to mitigate the whitebark pine habitat affected by the mine footprint.

Mining companies as well as individual mines generate public opinion in the local area and larger regions in which they operate. A positive opinion can lead to a 'social license to operate', whereby the public views the mine as doing more than just providing jobs and profits to shareholders. Although social license is somewhat conceptual, it is generally gained through concrete actions such as gaining feedback from locals, sponsoring community initiatives, and through environmental contributions; demonstrating care for the regions in which the mines operate. Mines cannot act unilaterally, but need to incorporate community concerns and needs in order to gain social license. As the public becomes increasingly aware of whitebark pine and its ecological significance, contributions to whitebark pine conservation may be a viable option for mining and exploration companies to gain social license in order to operate in these high elevation ecosystems. Although it is easy to view industrial development for its negative impacts on whitebark pine ecosystems, industrial partners could potentially enhance our capacity for research, restoration, and educational outreach.

People may view whitebark pine as occurring primarily in pristine protected areas such as national parks, but the reality is that whitebark pine also occurs within areas prone to development for mining. Developing cooperative relationships with industrial partners is a critical means to ensure effective mitigation of impacts to whitebark pine habitats. New Gold is heading in this direction, and other companies impacting whitebark pine should be encouraged to take similar action. (see figures 1 & 2) ■

Figure 1. Mature whitebark pine retained during exploration clearing on-site thanks to pre-clearing flagging.

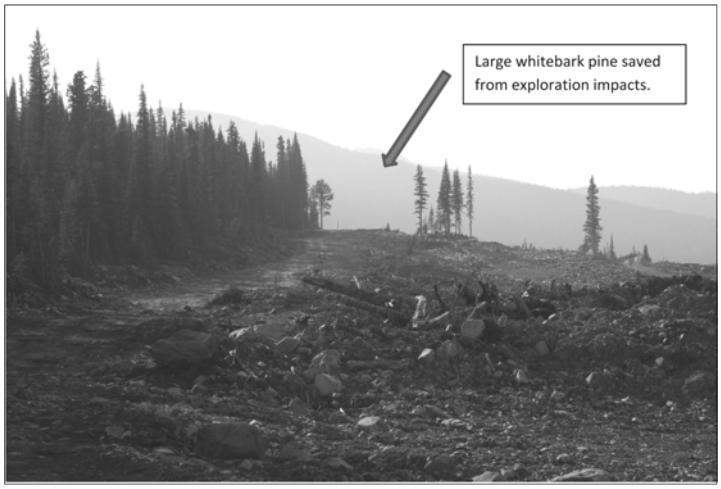


Figure 2. Salvaged seedlings to be used in restoration trials**.**

Innovation: Plastic Cone Cages

Don Pigott
Yellow Point Propagation Ltd.
Ladysmith, B.C.

Anyone working to collect whitebark pine seed soon realizes that it is almost always essential to protect the cones from predation by Clark's nutcrackers and red squirrels. This is particularly true when the cones are being collected from trees selected for, provenance trials, gene conservation, or resistance to white pine blister rust (*Cronartium ribicola*). The only time cages might not be required is in mast years when cones are especially abundant.

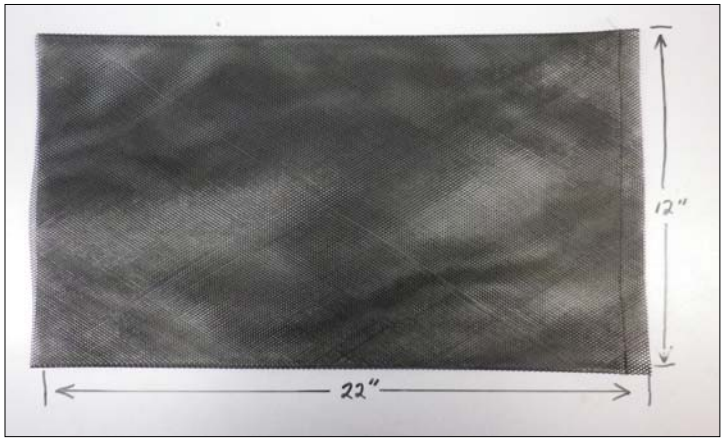
Cone protection has traditionally been provided by caging them in galvanized metal hardware cloth, either 1/4 inch or 1/8inch mesh. The larger mesh works

fine for whitebark pine as the cones remain intact upon maturity. In the case of limber pine, however, sometimes cones ripen prior to harvesting, they open, and seed may be lost through the coarser mesh.

The metal cages are extremely effective at preventing both the Clark's nutcracker, and squirrels from eating or harvesting the cones. Unfortunately, there are several disadvantages:They are relatively expensive and time-consuming to construct; they are awkward to handle and pack into the field, especially to sites without motor vehicle access; and gloves are needed to install the cages or your hands will look like you were on the losing end of a fight with a feral cat.

In 2012 we found a plastic mesh material used in the aquaculture industry that may have promise as a substitute for metal cages.The material is available through aquaculture supply stores or Norplex Industries from Auburn, Washington. The material, Norplex HNT 1812-35, comes as a tube in a 250 foot roll which costs about $60. Flattened, the tube is 12" wide. The material can be cut into suitable lengths for cages, and then one end is sewn shut, preferably on a commercial grade sewing machine. In our case we cut the tube into 22" pieces, and the cost of the material for each cage was less than $0.50.

Dimensions of plastic cage. Note sewn edge on right.



Assembled plastic cage. End tied with 14 gauge wire.

Unfortunately, there were generally poor crops of both limber and whitebark pine in 2012. We only had the opportunity to test the cages on limber pine cones at one site at Columbia Lake in British Columbia's East Kootenay region, an area with a healthy population of both Clark's nutcrackers and red squirrels

We installed the plastic cages over cones on 11 trees in early July. The primary purpose of the collection was to harvest seed for *ex situ* gene conservation. On this first attempt we fastened the cages at the bottom with releasable zap ties. The cones were collected in the last week of August by Dave Couse of Keefer Ecological Services from Cranbrook , BC

After collection, Dave had the following comments:

- ⇒ good for packing and handling since they are flat, light-weight, and easy to handle without gloves.
- ⇒ hold limber pine seed when the cones open
- ⇒ they didn't seem to have any effect on heating the cones or shading them out.
- ⇒ easy removal; no need to break down the cages for packing out
- ⇒ I did have trouble getting them to slip over the cones at times. Once the needle tips caught in the mesh, there was resistance to pulling the cage into position
- ⇒ Need longer zip ties. I like them, but need to figure out a way to have the bottom part stay open easier for installation.

In light of these comments, I subsequently tried using 14-gauge plastic-coated wire to tie the end of the cages and it seems to work quite well. The problem of mounting the cage over the branch and cones still needs to be addressed. I plan to try a lightweight plastic insert (perhaps a hoop or tube that opens for removal) to keep the leading edge of the cage open.

In conclusion, I think these plastic cages could prove very useful for the protection of both limber and whitebark pine cones from predators. Some improvements are needed, and comments or suggestions would be greatly appreciated. Contact me at ypprop@shaw.ca.

Thanks to Dave Couse for his assistance, photo and comments.

The purpose of the Board of Directors (BOD) is to make decisions affecting the general membership of the WPEF. This includes making policy, deciding on major spending, or solving major problems concerning the organization.

1. Responsibilities of the Director:

- **Specific**
  - Call and lead board meetings twice a year
  - Share relevant information
  - Develop agenda for board meeting
  - Develop agenda for annual members meeting
  - Call for host/location for annual members meeting
  - Propose initiatives meeting WPEF mission
  - Call for initiatives meeting WPEF mission
  - Follow potential leads for fund-raising and initiatives
- **General**
  - Oversight of all WPEF activities
  - Interface with external constituencies on matters relating to WPEF & whitebark pine
  - Oversee fund-raising & Public Relations
  - Participate in meetings; make presentations at important events relative to WPEF mission
  - WPEF will provide reimbursement for activities that are of impact to WPEF and not funded by external sources.

2. Responsibilities of the Secretary:

- Serve as the Election Official for all voting activities
  - Notify membership of each ballot
  - Collect and organize all completed ballots
  - Report to the BOD on election results
  - Store all ballots and results
  - Compile a report on voting activities for newsletter
- Maintain WPEF bylaws and handbook
  - Record any changes as approved by the BOD
  - Update the bylaws or handbook
  - Post changes to website and newsletter
  - Create a ballot if changes to bylaws are warranted
- Record all activities of the Executive Committee and BOD
  - Attend BOD meetings and record minutes
  - Record email votes and notify Director of outcome
  - Compile a record of all emails, letters, and web postings
  - Distribute draft copies of minutes within 4-6 weeks following BOD meetings

3. Responsibilities of a general board member:

- Members of the WPEF Board of Directors (BOD) that are NOT members of the Executive Committee have the following responsibilities:
- Attend all BOD meetings
- If it is impossible to attend, the BOD member must notify the Chair of the Executive Committee as to their absence.
- Attendance can be in person or via a conference call.
- Attend all WPEF annual meetings
- Participate in WPEF activities when appropriate
- Form Working Groups
- Organize annual meetings
- Volunteer for Evaluation Committee
- Perform fundraising as needed
- Other tasks as needed

Erect foxtail pine and sprawling limber pine at 11,000 feet elevation near Mount Whitney, CA (S. Arno photo)

Metal cone cage. Photo by Dave Couse

Figure 1 from Foushee article.
One year after hot grafting.

Installing plastic cage