



Issue No. 17: Fall / Winter 2009

Nutcracker Notes

Whitebark Pine Ecosystem Foundation



photo by Cyndi Smith



photo by Michael Shuster

WPEF

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Whitebark Pine Ecosystem Foundation
Nutcracker Notes, Issue No. 17; Fall/Winter 2009

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Web Site: www.whitebarkfound.org

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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>

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Diana F. Tomback

High time for "High Five"

[At this time] The WPEF is busy planning our 2010 symposium "High Five: The Future of High-Elevation Five-Needle White Pines in Western North America." "High Five" will be held at the University of Montana from June 28 to 30 (see accompanying article). This meeting is a "must attend" for all researchers and managers who work with whitebark, limber, southwestern white, foxtail, and the two species of bristlecone pines, or who study or manage the various threats to these pines.

These high elevation white pines represent diverse ecological communities throughout the West, both the U.S. and Canada, and provide an array of ecosystem services. All six pines are susceptible to blister rust, and five of the six (all but Great Basin bristlecone pine) are already infected with blister rust in their natural ranges. Furthermore, all six pines are experiencing mortality from mountain pine beetles and advancing succession linked to fire suppression, and all are vulnerable to the effects of climate change. "High Five" will encourage development of restoration plans for these pines.

"High Five" is the third major symposium to examine high elevation white pine forests over a 21 year period. The first of these was held at Montana State University, Bozeman, in 1989. Entitled "Whitebark Pine Ecosystems: Ecology and Management of a High-Mountain Resource," it focused on whitebark pine with a predominantly Rocky Mountain perspective because declines in whitebark pine were most apparent in this region. This pioneering symposium was organized by an ad hoc group of researchers and managers concerned about growing losses of whitebark pine who had met periodically at the Missoula Fire Sciences Laboratory since the mid-1980s to discuss their findings and establish new research needs. This group organized the 1998 symposium, "Restoring Whitebark Pine Ecosystems," held in Missoula. WPEF and its book *Whitebark Pine Communities: Ecology and Restoration* were an outgrowth of this symposium.

More recently, there have been several regionally-focused whitebark pine workshops including one in Calgary in 2003, West Yellowstone in 2004, at Southern Oregon University in 2006, and Whistler, B. C., in 2007. But also in the last decade we have witnessed major losses of whitebark to an ongoing, massive outbreak of mountain pine beetles, and the spread of blister rust and mountain pine beetles within populations of the other high elevation five-needle white pines. The interest in these pines has been growing: We have

new information and restoration approaches, but also heightened threats to these pines and their habitats. Thus, WPEF offers the "High Five" symposium to provide another major opportunity for networking and information exchange, but with broader geographic and ecological focus, and increased urgency.

Our goal for "High Five" is to bring together researchers and managers from geographic regions throughout the ranges of these pines, from both Canada and the U.S., to offer their knowledge and perspectives. We are interested in geographic differences in basic ecology, threats, and management approaches. This conference is also an important opportunity for the experts on blister rust, mountain pine beetle, disturbance ecology, and climate change to teach us about their systems, laying out what we know and do not know.

We intend for this meeting to showcase new information or syntheses of current knowledge on all aspects of these pines, including ecology, wildlife interactions, genetics, rust resistance screening, health surveys, management strategies, and many other topics. Information will be conveyed through a combination of plenary talks, special concurrent sessions, contributed oral and poster papers, and panel discussions. There should be many opportunities for networking and information exchange. A conference proceedings is planned, to be published by the USDA Forest Service's Rocky Mountain Research Station.

I hope that all WPEF members will promote this meeting to coworkers and colleagues: Remember--this is the event of a decade!

WPEF meets at Nelson, B.C.

The charming town of Nelson, British Columbia, on the shores of Kootenay Lake at the base of the Selkirk Mountains, was the site of the WPEF fall meeting and scientific program September 9-11 (see accompanying article). The banquet room of the historic Hume Hotel, accommodated a well-attended scientific program comprised of presentations primarily from Canadian researchers and managers.

At the end of the presentations, long-time WPEF member Randy Moody led a discussion about establishing a Canadian Chapter of the WPEF, explaining the likely logistics involved and the benefits. A number of individuals supported this proposal, and provided a mandate to advance this effort.

The morning of the final day of the meeting, we embarked on our field trip, which began with a scenic ferry ride across Kootenay Lake and a drive up to whitebark pine habitat in the Purcell Mountains. It came as no surprise to most that the whitebark pine in the region is afflicted with both blister rust and mountain pine beetles—familiar problems to us from the U.S.—but it was sobering nonetheless to see this first hand. We are grateful to Michael Murray, a member of the WPEF Board of Directors, and his colleagues at the B.C. Ministry of Forests, for organizing a highly successful meeting and field trip. We thank Diane Douglas, B. C. Forest Genetics Council, for contributing financial support for this meeting.

WPEF's new brochure

The WPEF has a new color brochure that tells the whitebark pine "story" and encourages people to join us. Jane Kapler Smith, who heads our Education Committee, wrote the text with lots of BOD interaction, and rounded up some excellent pictures. We are pleased to send packets of these brochures to WPEF members who will distribute them at professional meetings or other venues. Please e-mail Helen Smith (hsmith04@fs.fed.us), WPEF Secretary, if you would like a packet.

Housekeeping and miscellaneous

2009 Election results: We welcome Kirk Horn from West Yellowstone, MT, to the Board of Directors (BOD). Congratulations also to Shawn McKinney—who was originally a replacement appointment—for his election to the BOD. We are pleased to have Kate Kendall and Bryan Donner reelected to the BOD. Our sincere thanks go to Dan Reinhart, who declined to run again for the BOD, for his service to our mission. Dan assures us that he will continue to work with the WPEF as an active member.

2010 elections: Please see the call for nominations for the 2010 elections elsewhere in this issue. Among other BOD positions, the position of Director of the WPEF is up for election. As of 2010, I will have served in this position for nine years, and it may be time for some fresh perspectives and younger energy! Please do not be shy to step forward as a candidate!

Update on "Endangered Species": As discussed in the spring-summer issue of *Nutcracker Notes*, in December 2008 the Natural Resources Defense Council submitted a petition to the U.S. Fish and Wildlife Service to list whitebark pine as an endangered species. The initial 90-day evaluation of the petition was delayed by transition to the new presidential administration and late approval of the 2009 federal budget. Responsibility for evaluating the petition was assigned to the Cody, Wyoming, office of the U.S. Fish and Wildlife Service. The initial 90-day evaluation is currently in draft form and being reviewed. The draft report is due to the Denver Regional Office in February 2010. At this time, the time-line for the official 90-day decision is July 2010; the decision will be reported in the Federal Register.

Whitebark implicated in Yellowstone grizzly re-listing: U.S. District Judge Donald Molloy recently reinstated protection under the Endangered Species Act for the Yellowstone population of the grizzly bear. Judge Molloy cited the dramatic decline in whitebark pine in the Greater Yellowstone, as a result of recent mountain pine beetle outbreaks, forest fires, and other threats as one of several reasons for his decision. According to news reports, Judge Molloy's ruling underscores the need to protect habitat in order to protect species. His view of habitat protection for species under the ESA reflects the opinion of many in the conservation community. ■

High Time for a "High Five" Symposium

Conferences focused on whitebark pine have been held at about 10-year intervals (most recently in 1998) as research findings accumulated to a critical mass, and it is again time to take a look at our high-elevation forests. Urgency is even greater this time around because of rapidly expanding white pine blister rust, an unprecedented mountain pine beetle epidemic, and climatic change that threatens all high-elevation five-needle pines (whitebark, limber, foxtail, southwestern white, and Great Basin and Rocky Mountain bristlecone pines). Concerns over rapidly deteriorating conditions have spurred the WPEF (Whitebark Pine Ecosystem Foundation) to organize a West-wide, trans-boundary conference that addresses all higher-elevation five-needle pines – the 2010 High Five Symposium. Given the escalating threats to five-needle pines, this event is a crucial coming together of all concerned – scientists, managers, educators, students, and citizens – to share what we know and what might be done to sustain and restore these ecosystems. The 2010 symposium builds on the previous conferences by (1) addressing all high-elevation five-needle pines, (2) including Canadian scientists and managers, (3) highlighting management and restoration experiences and lessons learned, and (4) integrating new knowledge toward a unifying vision for future action.

The High Five Symposium has three components – plenary sessions, contributed sessions, and field trips. The plenary sessions are comprised of seven talks that summarize research and management knowledge for the High Five pines on topics ranging from ecology to genetic resistance to restoration techniques. Contributed sessions give researchers, students, and managers an opportunity to share study results and observations. The four concurrent sessions of contributed papers consist of a key opening presentation followed by contributed presentations, and in some cases a discussion session featuring a special topic, such as restoration strategies or mountain pine beetle issues. The third part of the symposium involves a field trip to Snowbowl Ski Area to visit an ongoing restoration site and to discuss high-elevation ecology, and an optional field trip to "Flexicaulis Ridge," where whitebark and limber pines occur together.

Conference organizers are currently accepting abstracts (deadline March 1, 2010) for consideration as contributed presentations or poster papers. Presentations or posters can be on any subject associated with the ecology and management of the High-Five pines including ecology, genetics, resource issues, disturbance ecology, restoration science and applications, and management projects and actions. Restoration experiences and cone-collection projects may be especially appropriate in a poster format. See the announcement on the next page for more information.

Organizers are also accepting proposals for special sessions. Anyone who wants to organize a special session around a specific topic needs to pro-

...Continued on page 6



High Five:

The Future of High-Elevation Five-Needle Pines in North America



Call for Abstracts

Five-needle white pines are rapidly declining throughout western North America. A comprehensive symposium presenting the latest research findings and approaches to managing these critical species will be held June 28-30, 2010 at the University of Montana in Missoula. The symposium will be comprised of one plenary session, a number of concurrent sessions, and a field trip day. Managers, researchers, students, administrators, and all others interested in high elevation ecosystems are invited to attend. More information on the symposium can be obtained at www.umt.edu/ce/cps/highfive/.

Abstracts are now being solicited for the concurrent and poster sessions on a number of diverse topics that concern all fields in the study of whitebark, limber, foxtail, southwestern white, Rocky Mountain bristlecone, and Great Basin bristlecone.

Abstracts can be submitted in the following areas:

Ecology

- General ecology
- Climate-vegetation dynamics
- Bird-pine interactions
- Successional dynamics
- Wildlife interactions

Genetics

- Taxonomy
- Blister rust resistance
- Geographic variation

Resource Issues

- Recreation
- Silviculture
- Legal status
- Wilderness

Disturbance Ecology

- Fire ecology
- Mountain pine beetle interactions
- Blister rust dynamics
- Climate change
- Assessment of decline

Restoration Research and Applications

- Planning: prioritization, location, selection
- Treatments: prescribed fire, mechanical cuttings, wildland fire use
- Cone collection

- Stand vs. landscape considerations
- Enhancing rust resistance: screening, plus-tree selection, seed storage
- Nursery methods
- Planting
- Monitoring

Management Projects and Actions

- Active restoration projects
- Regional management plans

We encourage you to submit your abstract on the conference website. Abstracts must be no longer than 500 words and include: 1) a title that has fewer than 15 words, 2) a list of authors with contact information (full name, affiliation, address, email), and 3) no more than five keywords. Detailed instructions and the abstract format are available on the conference web site (www.umt.edu/ce/cps/highfive/). A symposium proceedings is planned for publication of all concurrent session presentations. Authors have the option of submitting an abstract, extended abstract, or full paper. These proceedings will be published by the Rocky Mountain Research Station, USDA Forest Service.

...Continued from page 4

vide a list of presentation titles (with presenters) to Bob Keane (rkeane@fs.fed.us) before February 1, 2010. Presenters for the proposed session must submit abstracts by the March 1, 2010 deadline. Special sessions are composed of five, six, or 11 presentations, and one of the presentations can be in a discussion format.

Given the importance and timeliness of this conference, we hope that land management agencies, non-government organizations, and educational institutions will give the High Five Symposium special consideration when allocating scarce training and travel dollars. Considerable effort has been made to keep the conference registration affordable. A limited number of "scholarships" will also be available to students in the form of a registration fee waiver. In exchange for a fee waiver, students will be required to help with registration, the poster session, or other tasks as needed during the conference.

Information concerning the conference date, location, agenda, abstract submission, and registration is shown below (along with associated web links).

Date and location: The symposium will be held June 28-30, 2010, on the third floor of the University Center, University of Montana campus, Missoula, MT (see web link) <http://www.umt.edu/ce/cps/highfive/>

Abstract submission: Abstracts are due March 1, 2010 (see web link).

<https://www.umt.edu/ce/secure/cps/highfive/login.aspx?ReturnUrl=%2fce%2fsecure%2fcps%2fhhighfive%2fDefault.aspx>

Registration: The registration fee is \$200 (student fee is \$75), with a limited number of fee waivers available for students. The fee includes program, evening social, one buffet lunch, and field trip transportation and box lunch (see web link).

<https://www.umt.edu/ce/secure/cps/highfive/Registration.aspx> ■

Whitebark Pine Restoration Program

John Schwandt, Program Coordinator
jschwandt@fs.fed.us

The Whitebark Pine Restoration Program was initiated in 2006 following a range-wide health assessment that found this critical species to be declining dramatically throughout the West.

The Whitebark Pine Restoration Program promotes all phases of restoration from development of strategic restoration plans to gene conservation, health monitoring and surveys, silvicultural treatments and planting, as well as educational and public outreach programs. The program has grown every year and although requests far outweigh funding levels, the program has now helped to fund nearly 100 projects throughout the West (see table).

Whitebark Pine Restoration Program History

Matching funds have more than doubled the initial investment, and have come from a broad and diverse group of state and federal agencies, universities, ski ar-

	2007	2008	2009	2010
# Proposals Received	56	62	60	38
Total \$ Requested	\$1,000,000	\$2,200,000	\$960,000	\$690,000
# Projects Funded	24	26	43	9 +?
\$ Forest Health Funds	\$267,400	\$398,900	\$385,000	\$150,000+?
\$ Match	\$291,700	\$433,900	\$550,000	\$615,000 ?
Total	\$559,100	\$832,800	\$935,000	?

eas, national parks, and private foundations. The Whitebark Pine Ecosystem Foundation contributed \$30,000 to the 2009 program which helped fund planting and sowing projects on the Lolo, Flathead, Idaho Panhandle, and Clearwater National Forests. Many WPEF members have been involved in implementing projects and have been greatly responsible for program success. As a tribute to this success, the Whitebark Pine Restoration Program received the Region-1 Regional Forester's Natural Resources Stewardship Award in 2009.

2010 Plans

In spite of having to move the requests for proposals to the field season, we received 38 proposals requesting over \$690,000 for 2010. Proposals came from national forests, national parks, universities, and outside groups across the range of whitebark pine. Final project selections await funding distribution for several federal programs, but we hope to fund many of these projects.

Our goal is to enhance restoration of whitebark pine in the face of losses from bark beetles, competition, fire, and especially white pine blister rust - an introduced disease. We still have a long way to go, but hope that these restoration efforts will continue to grow so that whitebark pine will continue to play an important role in high elevation ecosystems. ■

WPEF Conclave at Nelson, B.C. A Rousing Success!

Steve Arno

Only once in the past has WPEF held its annual meeting and field trip in Canada --2005 at Waterton Lakes National Park. This fall we chose the small mountain-locked town of Nelson in southeastern, British Columbia, with some



Michael Murray

concern that location and the ongoing recession might prevent a good turnout. I'm glad to report that these fears were unfounded; WPEF garnered 53 attendees

to its science and management conference, and a few additional folks joined the field trip. The conference also proved to be a successful outreach effort, since two-thirds of the participants were Canadians with many newly introduced to WPEF.

The conference and field trip were expertly organized by WPEF board member Michael Murray, who moved to Nelson from Crater Lake National Park in 2008 to accept a position in the B.C. Ministry of Forests. Downtown Nelson features Victorian-era buildings on tree-lined streets. "Hip" and retro/"hippie" cultures and tourists mix on sidewalks lined with diverse small shops. Michael's droll humor as moderator fit the occasion perfectly. Having read about the exploits of British naval super-hero Lord Nelson, I was primed when Michael welcomed us in Nelson historic Hume Hotel. Keeping a straight face, he explained that the town had been named for aging country singer Willie Nelson (a great cultural match), who had once visited. (I nearly fell off my chair!)

Eleven of the fifteen presentations focused on whitebark and limber pine conservation in Canada, where their precarious status is being recognized at provincial levels. Speakers included university researchers, ecological consultants, B. C. and Alberta government biologists, and Parks Canada staff. Our field trip to whitebark pine habitat began with a half-hour ferry ride under a gloriously sunny sky across magnificent Kootenay Lake, which is squeezed between lofty mountain ranges. Then, busses labored to ascend 4000 feet into whitebark pine and alpine larch habitat in the scenic Purcell Range. Several Canadian foresters, scientists, and natural resource specialists recruited by Michael spoke and fielded questions about topics as varied as whitebark pine regeneration on high-elevation clearcuts, techniques for caging cones, and factors involved in bark beetle outbreaks. During a lunch stop, I spoke briefly about the ecology of alpine larch surrounded by a nearly pure stand of these hardy trees.

The cultural and conservation exchanges involved at WPEF's annual conclave were memorable and rewarding. I hope readers will keep this in mind and join us for the "High Five" symposium and field trip(s) in 2010. ■

WPEF Chapter for Canada?

Randy Moody, Keefer Ecological Services Inc.,
Kimberley, B.C. (randy@keefereco.com)

Some Canadian members of WPEF are exploring the options for creating a Canadian "chapter" of the organization. We have been discussing this proposal with WPEF's board of directors over the past year, and learning how other U.S.-Canadian non-profit organizations have established a coordinated, official presence in both countries. Although WPEF already has a substantial Canadian membership, until we have an official affiliate in Canada WPEF cannot secure grants to aid research and restoration of whitebark pine north of the border. This obstacle will be removed if WPEF be-

comes a legal entity in Canada; thus the new "chapter" will be a registered non-profit society in Canada. The creation of a Canadian branch of WPEF should enhance the status of and create greater opportunities for WPEF and its mission in both countries. To limit duplication of efforts, all memberships would continue to be handled through the current U.S.-based organization, which is already doing an excellent job as a voice for whitebark pine. Canadians who are interested in aiding this endeavour are invited to contact me by e-mail. I hope to be able to report on a finalized proposal in the next issue of *Nutcracker Notes*. ■

Interview with Kirk Horn (newly elected WPEF board member)



Kirk Horn, at left, on WPEF field trip

Editor: How did you and Beth discover WPEF?

Horn: We learned of the WPEF five years ago when we heard about and attended the WPEF workshop that was held in our community [West Yellow-

stone]. Because of my involvement in the grizzly bear recovery program and the bear's relationship with whitebark pine, I wanted to become acquainted with the research and WPEF. Beth and I were impressed with the professionalism of the WPEF and the research it was involved in, so we decided to join.

Editor: You and Beth have had long careers in natural resources, and continue to be actively involved as retirees. Please give us a brief summary.

Horn: From my days as an undergraduate and graduate student I've been interested in natural resources, and especially in wildlife management. Beth's graduate studies and research in plant ecology made us a family of natural resource advocates. I served as a wildlife biologist on different national forests in Oregon and Washington, regional biologist for the USFS in Portland, and Director for Threatened and Endangered Species with USFS in Washington, D.C. I also taught biology in an Oregon high school, and field ornithology at the college level. After retiring as Regional Director of Fish, Wildlife and Rare Plants from USFS in Missoula, I continued natural resource work with the Rocky Mountain Elk Foundation, developing a GIS mapping system of elk winter range in U.S. and Canada, conducting bird watches with National Audubon Society, and as a naturalist with the Wolf and Grizzly Discovery Center in West Yellowstone.

Editor: You and Beth made an unusual choice by retiring to West Yellowstone, one of the coldest towns in the lower 48 states—your comments?

Horn: Our retirement and move to this high mountain environment was tied to our love of natural re-

8 sources—specifically botany and wild critters. Despite its rather remote location, West Yellowstone attracts many other folks who share our interests. We have enjoyed working with the Native Plant Society, National Audubon Society and other groups to interpret and educate folks about plant and wildlife conservation. In retirement, we have become increasingly aware that ecosystems and their wild critters are more complex and fascinating than we can even imagine. ■

Election News

Cyndi Smith, WPEF Associate Director

In spring, 2009, the WPEF solicited nominations for a number of positions on the Board of Directors (BOD). Bryan Donner was re-elected as Membership Coordinator by acclamation. Five individuals ran for three positions as general members of the BOD, and the following people were elected: Kirk Horn, Kate Kendall and Shawn McKinney. We thank all of the candidates for running.

In the first year of elections (2007), 36% of the membership voted, which dropped to 14% in 2008 and 15% in 2009. In an effort to increase participation, we are investigating possibilities beyond mailing in of ballots, such as e-mailing of completed ballots and secure online voting. If you have other suggestions to improve the process, please contact me at <cyndi.smith@pc.gc.ca>. ■

Renew Using WPEF Web Site

Bob Keane, Missoula Fire Sciences Laboratory

Big things have been happening on WPEF's web site (www.whitebarkfound.org) during the past few months, and perhaps most important is the addition of PayPal for purchasing merchandize and books and for renewing memberships. Our webmaster, Chuck Crouter, has implemented the PayPal system, so users can make transactions conveniently using their credit card. This new option on our web site has already increased membership and orders for merchandize. The PayPal billing method also provides WPEF's treasurer with a continuous record of transactions. We encourage WPEF members to consider this method for their annual membership renewal each fall; but of course those that prefer to mail WPEF a check for renewals are welcome to continue doing so.

To use the PayPal feature, people must establish a PayPal account by going to www.PayPal.com and following the simple instructions for signing up. Then, go to the WPEF web site and order merchandize or pay for your membership by hitting the "Add to Cart" button. This will bring up a PayPal log-in page, and the rest is easy.

Other updates to our web site include improvements on the "Ecology and Management" page and the post-

ing of *Nutcracker Notes* and more publications concerned with whitebark pine restoration. Please visit the web site, and suggest any changes you would like to suggest by clicking "Contact Us" on the "About Us" page. ■

Southwestern White Pine

David A. Conklin, USDA Forest Service
Albuquerque, NM

Southwestern white pine (*Pinus strobiformis*) ranges from southern Colorado to central Mexico. It occurs in most of the higher mountains of New Mexico, Arizona, and west Texas. There are more than 30 disjunct, genetically isolated populations in New Mexico and Arizona alone. This tree is closely related to both limber pine (*P. flexilis*) and Mexican white pine (*P. ayacahuite*). It appears to intergrade with limber pine in the northern portions of its range. It is found over broad elevational and ecological gradients, occurring in at least 40 different plant associations or habitat types in New Mexico and Arizona. It most often occurs as a minor to significant component in mixed conifer forests; common associates include ponderosa pine, Douglas-fir, and white fir.

Southwestern white pine is an attractive tree and has value for wildlife and commercial timber. Compared to limber pine, it tends toward faster growth, reaching greater size and often maintaining better form. On good sites it can grow to 90 feet tall and over three feet in diameter. However, it is early to mid-successional and often a poor competitor in dense mixed stands. Like other white pines, southwestern white pine is ecologically well-adapted to fire. Fire scars on older southwestern white pines have provided some of the best data on fire history in the Southwest. As with other white pines, it has large seeds that are an important food source for several species, including Clark's nutcrackers and red squirrels. ■

Limber Pine

Anna W. Schoettle
USFS, Rocky Mountain Research Station
aschoettle@fs.fed.us

Limber pine has a patchy distribution that spans a broad latitudinal and elevational range across most of the West. This tree often defines the boundaries of habitats suitable for tree growth, forming lower and alpine timberlines. Its broadest elevation range is in northern Colorado where it occurs from below the lower tree line on rocky outcrops in the short-grass steppe up to the alpine treeline along the Continental Divide. Elsewhere it is commonly restricted to mid- and low- elevation habitats with the higher elevations occupied by whitebark pine to the north, Great Basin bristlecone pine to the west and Rocky Mountain bristlecone to the south. Southward in New Mexico and Arizona, limber pine and southwestern white pine are suspected to hybridize and ultimately the complex is

replaced by southwestern white pine.

Limber pine trees are slow to mature and can survive for over 1600 years in dry windswept habitats. The temporal and spatial patterns of establishment can vary among sites but limber pine is often early seral after stand replacing fires. On more moist forested sites limber pine facilitates succession to spruce and fir; likewise as it encroaches on to the grasslands in Montana it facilitates the expanded distribution of Douglas-fir. Limber pine often grows in small widely-separated populations, which might limit genetic exchanges and increase the potential for local extinctions. Its distribution is consistent with the long-distant bird dispersal of its large near-wingless seeds.

White pine blister rust (caused by *Cronartium ribicola*) was first found on limber pine in 1945 and continues to spread. In 2009, limber pine in Alberta was listed as an endangered species under The Wildlife Act. Rust resistance has been identified in the southern Rockies populations, and further studies are ongoing. Limber pine is a preferred host for mountain pine beetle (*Dendroctonus ponderosae*), and beetle-caused mortality of limber pine is currently very high in portions of the pine's distribution, even in populations at the alpine treeline. Protection of limber pine from mountain pine beetle attack is currently ongoing in limber pine populations with genetic resistance to blister rust in the Southern Rockies. Gene conservation efforts are also underway. Learn more about limber pine and the factors that threaten them at the High Elevation White Pine website <http://www.fs.fed.us/rm/high-elevation-white-pines/trees/limber.htm> ■

Foxtail Pine

Ron Mastrogiuseppe,
Crater Lake Institute

Foxtail pine (*Pinus balfouriana*) is confined to sites near the alpine treeline in the southern Sierra Nevada and scattered high peaks in the Klamath Mountains complex of extreme northwestern California. These northern and southern populations are separated by about 300 miles, and are classified as different subspecies. Foxtail pines are and are closely related to the bristlecone pines of the Great Basin and Southern Rocky Mountains and have foliage and cones of generally similar appearance. Their foliage consists of inch-long clusters of five needles which clothe long branchlets in a manner resembling a fox tail, largely because a given year's new crop of needles persists about 17 years.

Despite extremely harsh growing conditions—wind-exposed rocky sites with scant undergrowth—foxtail pine forms an erect tree, often 4 to 5 feet in diameter (DBH), and despite the species very limited range, in the southern high Sierra it is often abundant.

The Klamath populations are at their upper ecological range atop the highest mountain peaks, and there is

little potential habitat above for future range expansion under a warming climate. Conifer associates include incense-cedar (*Calocedrus decurrens*), red fir (*Abies magnifica-procera*), white fir (*A. concolor*), lodgepole pine (*P. contorta*), Jeffrey pine (*P. jeffreyi*), and western white pine (*P. monticola*).

The southern populations grow in pure or nearly pure stands at the headwaters of the Kings, Kern, and Kaweah Rivers of southern Sierra Nevada, largely between elevations of 10,000 and 11,000 feet, where there is a substantial amount of adjacent, higher alpine terrain. Conifer associates are primarily lodgepole pine, western white pine, whitebark pine, and red fir.

Foxtail pines in the Klamath population obtain maximum ages estimated at 1000 to 1500 years, while the Sierra foxtails attain even greater ages. Some of oldest Sierra foxtail pines have multiple piggyback trunks, like ancient Great Basin bristlecone pines, that formed when the original trunk succumbed to the elements, and a branch on the leeward side grew erect to replace it. Then the second trunk dies and is in turn replaced by a branch growing erect on the sheltered side.

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Rocky Mountain Bristlecone pine

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In 1970, Dana Bailey (*Annals of the Missouri Botanical Garden* 57: 210-249) split the North American bristlecone pine into two species, the Rocky Mountain bristlecone pine (retaining the name *Pinus aristata* Engelm.) and Great Basin bristlecone pine (newly named *Pinus longaeva* Bailey).

The distribution of Rocky Mountain (RM) bristlecone pine is centered in Colorado extending southward into New Mexico with a disjunct population in central Arizona. RM bristlecone is primarily a high elevation species occupying dry sites from 9000 to 12,000 feet in elevation. It grows in pure, open stands on harsh sites but also occurs in extensive mixed forests with limber pine, Engelmann spruce, subalpine fir, aspen, Douglas-fir or even ponderosa and pinyon pines.

RM bristlecone pine trees are slow to mature and can survive for over 2400 years. Regeneration is very sporadic and slow to become established, and the spatial patterns of regeneration are consistent with wind dispersal of the winged seeds. However, bird-dispersal may also occur.

White pine blister rust (caused by *Cronartium ribicola*) was first found on RM bristlecone in 2003 in south-central Colorado and rust incidence is still low. Studies of rust resistance are in progress and suggest resistance exists in the species. RM bristlecone pine is a host for mountain pine beetle (*Dendroctonus pon-*

derosae) and most populations are currently experiencing endemic levels of infestation although some are intensifying in the northern bristlecone pine stands. Gene conservation efforts are underway to preserve seeds and genetic resources for research, conservation and proactive restoration. Learn more about RM bristlecone pine and the factors that threaten them at the High Elevation White Pine website at <http://www.fs.fed.us/rm/high-elevation-white-pines/trees/RM-bristlecone.htm> ■

Great Basin Bristlecone Pine

Steve Arno

The Great Basin bristlecone pine (*Pinus longaeva*) has been known as the “world’s longest-living tree” ever since 1958 when Edmund Schulman’s article about this obscure denizen of desert mountains appeared in the *National Geographic*. Schulman studied GB bristlecone pines growing on a virtually barren site high up in the White Mountains of east-central California. The White Mountains rise up east of the high Sierra Nevada, in a “rain shadow.” Thus, at an elevation of 10,000 feet, precipitation, which falls mostly as snow, averages only about 12 inches. Many of the short, stocky, storm-wracked GB bristlecone pines here proved, by annual-ring counts, to be more than 4000 years old.

In 1970 Dana Bailey established that GB bristlecone pines differ from the Rocky Mountain bristlecones (*P. aristata*) found farther east, and that they should be separated as a new species. However, GB bristlecones do have “fox-tail”-like branchlets similar to their close relatives, the RM bristlecones and the foxtail pines of California. [*The Bristlecone Book* by Ron Lanner (Mountain Press, 2007) is an excellent source of information on all these species.]

GB bristlecone pines are confined to high mountains in Nevada, Utah, and east-central California. On the harshest sites, venerable trees look like “living snags.” The windward side of the original stem is dead and weather-polished, but the wind-sheltered side remains alive and bears foliage. Their extreme longevity is thought to be aided by the exposed gravel and rock substrate they inhabit which allows them to avoid competition from other species and damage from fire and decay organisms. On dry sites, limber pine is their most common associate, but it does not ascend as high in elevation. When GB bristlecone is occasionally found on a moist site, it can form a handsome, pyramidal crown.

On severe sites, a large percentage of the GB bristlecone pines develop from a clump of two or more individuals, suggesting that Clark’s nutcrackers may be involved. When the large-seeded limber pine and piñon pines at lower elevations fail to produce a cone crop, Ron Lanner surmises that Clark’s nutcrackers instead harvest the small, winged seeds of GB bristlecone. By burying seeds an inch under the gravelly, erosive surface, nutcrackers could greatly aid regeneration. ■

Cone predation of limber pine by red squirrels

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Red squirrels are a major cause of pre-dispersal seed loss and regeneration failure in conifers (Peters et al. 2003). Many limber pine stands in Alberta occur in single versus multi-species conifer stands. Stands with varying combinations of species having a 2-year (firs, spruce) versus 3-year cone maturation periods (limber and whitebark pine), may produce large numbers of cones in different years (i.e. masting), and experience different amounts of cone predation by squirrels. We hypothesize that cone predation levels, and the amount of seed available for regeneration is highly dependent on the occurrence of single species versus multi-species stands on the landscape, the synchronicity of masting between species of varying cone maturation length, and recent infestation levels within the stand. We hope that our findings may provide readily assessable indicators (e.g. post-dispersal cone surveys) for targeting conservation efforts in forest types that are most subject to seed-limitation.

Methods

Forest composition and infestation levels of white pine blister rust (WPBR) differ dramatically throughout limber pine’s range in Alberta. We selected a southern metapopulation (PH – Porcupine Hills) characterized by limber pine and Douglas-fir, with high levels of WPBR. We contrasted this landscape with the northernmost metapopulation in Alberta (KH – Kootenay Plains) which consisted of limber pine, lodgepole pine, and Engelman spruce, that had low levels of WPBR infection. Our collaborators from Parks Alberta, and the Northern Forestry Centre in Edmonton, provided extensive data on stand composition, and WPBR infestation levels to assist with study site selection.

In 2008-09, with funding from Alberta Tourism, Parks, and Protected Areas, and the Alberta Conservation Association, we assessed pre-dispersal cone predation by red squirrels and Clark’s nutcrackers. Cone predation will ideally be followed annually through 2010, which would allow us to identify temporal variation in cone predation by stand type over the course of one masting cycle (2008 and 2009 were non-mast years, while 2010 promises to be a mast year for limber pine). Each metapopulation contains eight and nine sampled populations, respectively, that vary from 1-20 km away from the nearest population. Tree species composition varies between populations, ranging from 100% limber pine to even mixtures of all species.

In each population, the number of cones was recorded on 40 healthy (or lightly infected) trees (880 trees in total) at two key periods each year: before squirrel predation (June/July), and following squirrel

predation (mid-September). In September counts, we also recorded the number of cones remaining on trees that were damaged by Clark's nutcrackers. Seed rain from cones remaining on the trees is being monitored in a limited number of stands, to estimate the density of seed produced, relative to the basal area of cone producing trees.

After observing few squirrel vocalizations in the spring of 2008, and 2009, we settled on systematic ground searches for middens using six parallel 400m long transects, spaced at 20 m intervals, in each population. We characterized middens in terms of their location, surrounding forest composition, size, proportion of scale composition by species, and status annually (active vs. inactive).

A study region-wide cone survey has been conducted annually for all mastling conifer species since 2007, to assess patterns of synchrony of limber pine to conifers with a 2-year cone maturation cycle.

Results and Discussion

In 2008, cone production was twice as high per tree in the high WPBR infected metapopulation (PH) (Fig. 1). Overall, squirrels predated cones at similar rates in both metapopulations (76 and 78%, respectively; however, there were more than twice as many middens in the more severely infected southern population).

This is a higher level of pre-dispersal cone predation than reported for white spruce (Peters et al. 2003) in boreal forests where squirrels attain peak densities (Kemp and Keith 1970). On a cautionary note, our values do not distinguish between cones removed as a result of squirrel predation and those removed by other causes, such as the wind or the Clark's nutcracker. Cone counts beneath trees, however, suggest these are minimal influences, as only a few years of cone production would account for cones on the ground.

Cone predation was highly variable between populations, ranging from 0% to nearly 100% (Fig. 1). Preliminary statistical analyses based solely on 2008 data suggest cone predation increases as tree basal area increases; however, tree species composition, and midden proximity were not significant predictors.

At this point, we cannot infer whether the availability of multiple conifer species in a stand affects either squirrel density, or cone predation. In 2009 we expanded our study sites into pure limber pine stands; however, these sites are typically more open, which may confound our ability to test stand composition influences. Collaborations with grizzly bear researchers from the Foothills Research Institute will provide additional information on squirrel abundance relative to stand types in mixed whitebark pine stands in northern Alberta.

These initial results suggest that red squirrels are significant cone predators of limber pine in the northern part of the species range. This contrasts with studies in other parts of its range, where squirrel middens are rarely seen in limber pine habitats (Kendall, pers. comm.).

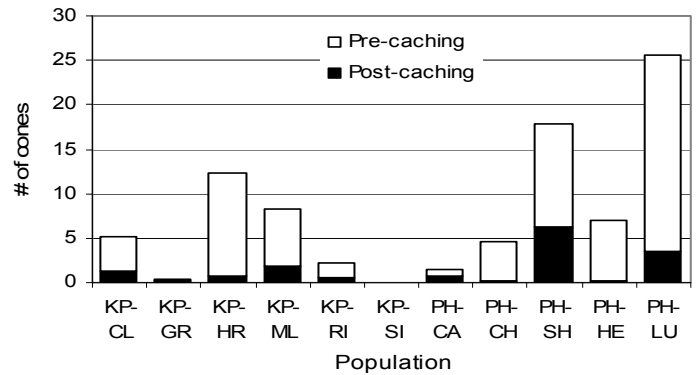


Figure 1: 2008 cone removal relative to cone production in limber pine populations ($n = 40$ trees/population). KP is the northern metapopulation, while PH is the southern metapopulation. In 2008, only 5 and 6 stands, respectively, were surveyed.

Management Considerations

Our study sites occur on private land, crown land, and ecological refuges. We are partnering with provincial government agencies (Alberta Tourism, Parks and Protected Areas, Alberta Sustainable Resource Development) and the Alberta Conservation Association, which are responsible for stewardship of the populations on their land base. The health of limber pine populations on protected lands depends on the stewardship of populations on private property as well (e.g. transfer of pollen, seed dispersal by birds). In 2008 we participated in the Adopt-A-Plant program, submitting all population locations to them, to ensure ongoing monitoring and contact with landowners.

Many populations of limber pine in its northern range have experienced considerable decline, and show limited capacity for renewal. Conserving this species will require rapidly identifying populations where the capacity for natural population growth exists, and targeting populations that are declining for mitigation measures. The number of cones remaining on trees after squirrel cone harvesting, and percent mortality of pines, are highly visible indicators that may help in recovery planning.

Education and Outreach

Additionally, the project has had a significant education component, involving 14 undergraduate students from The King's University College in the field research. Many of these students are writing B.Sc. theses on additional aspects of limber pine reproductive biology. They have served as excellent public relations advocates for limber pine conservation in their dealings with landowners.

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Planting Whitebark Pine in a Parking Lot

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Richard A. Sneizko, USDA Forest Service, DGRC,
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George Newcombe, University of Idaho, Moscow

The 8,000-foot rim at Crater Lake National Park (CRLA) features picturesque whitebark pine trees that frame glorious views of the deep blue lake. These venerable whitebarks have been a favorite of photographers since before the park's establishment in 1902. However, several years ago park ecologist Michael Murray became alarmed that many of these trees were dying from white pine blister rust, and more recently an outbreak of mountain pine beetles has killed many more of these trees.

In response to this threat to the park's whitebark pines, park biologists began collecting cones in 2003, and have continued such collections. Collection trees were selected in the field for their apparent blister rust resistance. Seeds were sown for rust-resistance testing at Dorena Genetic Resource Center (DGRC), and seeds from several parent trees were sown for field planting at CRLA. A total of 523 seedlings were planted at CRLA in fall 2009.

Two field plantings were undertaken. An out-planting of 331 seedlings was completed as part of a larger project involving the restoration of an old parking lot on the crater rim. When I (Laura Hudson) arrived as the new park ecologist in the fall of 2008, it seemed to be pretty straightforward; dig a hole in the mechanically churned

up pumice where grasses and a few shrubs had been seeded successfully in past years. However, after realizing it was almost impossible to put a shovel into this compacted supposedly-restored parking lot, we brought in a backhoe. We used it to install large rocks for seedling protection, and then with an auger attachment, to dig holes for planting. Due to the dry weather, we watered the seedlings each week until the first rain and snow fell in mid-October 2009. We will monitor these seedlings for survival over time and continue to plant additional seedlings if the mortality appears to be low.

A second outplanting of 192 seedlings was completed on an undisturbed site below the rim where a few whitebark pine seedlings become established naturally with no evidence of rust infection. Seedling populations were organized into a trial with a small number of seedling families, and with half the seedlings inoculated with endophytes (which might have beneficial mycorrhizal associations) specific to CRLA whitebark pine trees. The other seedlings serve as controls. Needles were collected from the original rust-resistant trees and the associated endophytes were grown in a lab at the University of Idaho, in a cooperative project with George Newcombe. All seedlings were tagged and will be monitored for rust resistance, growth and survival over time. Due to the dry fall conditions, we watered the seedlings once during the planting phase.

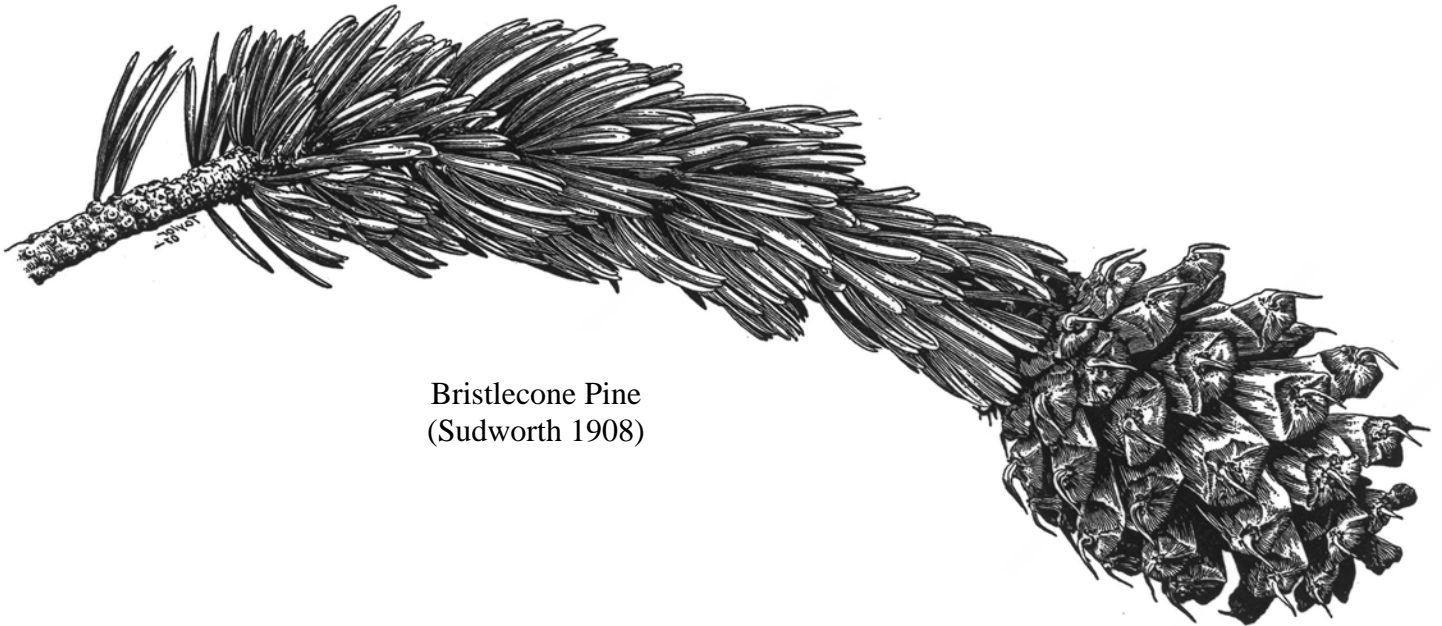
With an abundant cone crop in 2009, we intentionally collected from new candidate trees throughout the park to expand the sampling and research potential on a larger scale, including the first known collections from several sites including Wizard Island. For a separate project, over 1,000 needles were collected to confirm the findings by George Newcombe of a unique endophyte at CRLA, *Myrothecium roridum*, that is sometimes considered a pathogen and most commonly found in Asia

(http://www.pnwfungi.org/pdf_files/manuscripts_volume_4/naf20096.pdf). The park also completed its fifth year of data collection on seven long-term whitebark pine monitoring plots.

We hope to have more results to report from our whitebark pine restoration efforts next year. ■



Whitebark seedlings (not visible due to shadows) are planted in the shelter of the boulders.



Bristlecone Pine
(Sudworth 1908)

Identify these high-elevation pines!

Answers are at bottom of previous page.



A



B



C



D