Issue No. 21: Fall / Winter 2011

Whitebark Pine Ecosystem Foundation

Nutcracker Notes

Taking a break from caging cones and enjoying the views from the top! (see Krott article)

Hot-grafting whitebark. (see Anderson article)

WPEF
P.O. Box 17943
Missoula, MT 59808

WPEF Canada News

Randy Moody

The Whitebark Pine Ecosystem Foundation of Canada has had a productive summer and is excited about future opportunities on the horizon. In mid-July we hosted our first ever WPEF Canada meeting following the presentation-field trip layout established by the WPEF. We held the meeting at this time so as not to conflict with the annual WPEF science meeting. Our meeting was attended by nearly 40 individuals ranging from local guide outfitters and First Nations representatives to many of the familiar faces you see at WPEF events. The local naturalist club was of great assistance in coordinating logistics and will likely continue their work with whitebark pine in the future.

During the field day we visited some extensive recent burns that consumed large whitebark pine stands as well as a nearby healthy stand that escaped the fire. A few fortunate individuals were lucky enough to glimpse a grizzly bear; and nearly everyone was lucky enough to glimpse a whitebark laden bear scat, which may be the most photographed bear scat in British Columbia . It is hoped that these meetings may become an annual or bi-annual event. Given how far north from the Canada-U.S. border whitebark pine occurs, we feel that these WPEF Canada meetings throughout its northern range are an absolute necessity to ensure the public and local authorities are informed.

As I write this, all of us up here in Canada are waiting with bated breath for the Species at Risk Act (SARA) review, which is supposed to come down sometime in November. A favourable decision (listing) would lead to increased protection on Federal lands and hopefully some pressure on Provincial authorities to follow suit. Time will tell.

2012 WPEF Conference at Kimberley, B.C.

We are excited about the prospect of hosting the WPEF annual science and management meeting and field trip in Canada again in 2012. This event is being planned for the mountain resort town of Kimberley, B.C. in September (likely the 13-15th). Kimberley is situated in the East Kootenay region only about a 90-minute drive north from the U.S. border above Bonners Ferry, Idaho, or Eureka, Montana. We have staked out an excellent field trip site for mountain-top whitebark pine stands with an added bonus of alpine larch in brilliant fall color. Full details will appear in the next issue of *Nutcracker Notes* (May 2012) and on our web site www.whitebarkfound.org,, and announcements will be e-mailed to WPEF members. ■

Whitebark Pine Ecosystem Foundation

***Nutcracker Notes*, Issue No. 21; Fall/Winter 2011**

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

Web Site Contact Person: Robert Keane (address above)

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

Status of Whitebark Pine and the WPEF

Fall 2011 finds both whitebark pine and the Whitebark Pine Ecosystem Foundation at a crossroads. The WPEF just celebrated its 10th anniversary as a non-profit organization devoted to raising awareness of the importance of whitebark pine to western mountain ecosystems and the continuing decline of this keystone species. However, we are acutely aware of the need to increase both the effectiveness of our educational message and support for restoration. At the same time, the U.S. Fish and Wildlife Service (FWS) declared whitebark pine a candidate for listing as an Endangered or Threatened species under the Endangered Species Act (ESA), providing more urgent context for our work.

In 2008, The Natural Resource Defense Council petitioned the FWS to evaluate whitebark pine under the ESA. On July 19, 2011, the FWS published its 12-month finding on the petition to list *Pinus albicaulis* as endangered or threatened under the Endangered Species Act of 1973 (Federal Register, Vol. 76, No. 138, pp. 42631-42654). The conclusion:

> "After review of all available scientific and commercial information, we find that listing *P. albicaulis* as threatened or endangered is warranted. However, currently listing *P. albicaulis* is precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants."

In other words, whitebark pine has been placed on a candidate species list with a priority of 2, which is considered a high priority, but in the language of the Endangered Species Act, listing has been "precluded." The reason for this decision is discussed beginning on p. 42648: The FWS is backlogged with a number of species already on the candidate species list and awaiting official listing. The agency is limited by both funding and personnel in its ability to process these species but anticipates making progress over the next several years. It will periodically revisit the candidate status of whitebark pine, incorporating new information (p. 42654): "Continuing review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures."

The major causes of the decline of whitebark pine were cited as widespread infection by white pine blister rust and unprecedented mortality from mountain pine beetle, with climate change likely to escalate the losses.

> "Trends strongly indicate that white pine blister rust infections have increased in intensity over time and are now prevalent in even drier and colder areas originally considered less susceptible to infection. The other major threats, predation, fire and fire suppression, and environmental effects of climate change, which exacerbate some of the threats, also occur throughout the entire range and have resulted in significant loss of whitebark pine. We anticipate these threats to continue to impact *P. albicaulis* into the foreseeable future" (P. 42648).

For the short-term, these findings have important implications. On the one hand, management and restoration actions for whitebark pine are not complicated by the listing as Endangered or Threatened. But, now that whitebark pine is a candidate species, resource managers will consider whitebark pine in management decisions, and also facilitate restoration projects.

The WPEF was established in 2001in recognition of the serious decline of whitebark pine communities. We understood the likely downward trajectory for the species—from the combination of blister rust and the effects of fire suppression--which was hugely escalated by mortality from mountain pine beetles. None of us should be surprised that whitebark pine is now a candidate for listing under the ESA—you could say that we anticipated this outcome in 2001 but truly hoped to prevent it. At this time, the only factor that could potentially head off future listing is progress in the implementation of restoration at landscape scales in several regions across the range of whitebark pine. However, the scale and distribution of restored forest deemed sufficient to insure the survival of whitebark pine as a significant ecosystem component are likely to require a multi-generational human commitment.

At this time, the WPEF is developing both a strategic plan and an organizational plan in the attempt to increase the efficiency of our efforts and to meet the very serious challenges of our second decade.

10th Anniversary Celebration

We celebrated the 10th Anniversary of the Whitebark Pine Ecosystem Foundation in grand style, on September 16, in the spectacular setting of the Buffalo Bill Historical Center (BBHC) in Cody, Wyoming, adjacent to the Draper Museum of Natural History, with its unique interactive display of the ecosystems of the Greater Yellowstone. Our annual Whitebark Pine Science and Management Workshop, held in the Coe Auditorium was open to the public and had as many as 100 people in attendance. We celebrated the anniversary of the WPEF that evening in the reception area of the BBHC, followed by a public program on whitebark pine, including a presentation by Rebecca Turner from the conservation organization American Forests. The next day we had a large group of eager participants for our field trip to the

Beartooth Plateau northeast of Yellowstone National Park, despite biting winds and snow flurries.

The founders of the WPEF include myself, Kate Kendall, Helen Smith, Bob Keane, Steve Arno, Dana Perkins, Bryan Donner, and Ward McCaughey were nearly all in attendance We are grateful to a number of folks for the success of this event: Dr. Charles Preston, Senior Curator of the Draper Museum of Natural History; Charlene Margargal and Bruce Sauers and staff of the BBHC; Joe Alexander, Forest Supervisor of the Shoshone National Forest, and especially our liaison Kent Houston and field trip coordinator Randy Speering; Elizabeth Davy, head of the program organizing committee, which included Dan Reinhart, Michael Murray, and Cyndi Smith; invited speakers Rebecca Turner of American Forests, Amy Nicholas, U.S. Fish and Wildlife Service, Kelly McCloskey of Grand Teton National Park, and our own Bob Keane of the U.S. Forest Service Missoula Fire Sciences Lab; and, all other contributors to the workshop and evening program.

Collaborations

Recognizing the power of multiple organizations working together, especially capitalizing on different strengths, the WPEF is moving ahead in developing partnerships and collaborations. Last spring, the WPEF signed a letter of agreement with the national organization American Forests to work together to raise awareness of the importance of the high-elevation five-needle white pines, and to fund-raise for restoration of these species. WPEF will provide scientific advice, information, and photos for fund-raising activities and literature. Both organizations will collaborate on developing strategies to build funding capacity for restoration.

American Forests, established in 1875 as the American Forestry Association, is credited with initiating the American conservation movement. American Forests is concerned about the health of our nation's urban and wildland forests, and works to educate communities about forests as valuable resources but also to protect and restore forest ecosystems.

I attended the October 19th American Forests board meeting in Jackson Hole, WY, and presented an overview of the ecology and status of the high-elevation five-needle white pines, with emphasis on whitebark pine, followed by a brief field excursion by tram to whitebark pine at the top of the Rendezvous Mountain at the Jackson Hole Mountain Resort. The field trip was followed by a presentation by American Forests CEO Scott Steen, who officially announced a five-year campaign to raise funds for planting at least 70,000 acres of whitebark pine, as well as other white pines, focusing on Colorado, Wyoming, and Montana, and for educating the public and mitigating the effects of mountain pine beetle and blister rust. The effort was estimated as costing as much as $10 million.

Currently, the WPEF is formalizing a relationship with a long-term partner, the Northern Region of the National Forest system. This formal agreement is an outgrowth of a productive meeting with Regional Forester Leslie Weldon and several of her staff last spring. The agreement enables the WPEF to provide technical expertise concerning the management and restoration of whitebark pine, assist with public outreach, periodically organize science and management events for the dissemination of new information, and engage in other collaborative projects. We are working with Glenda Scott, Reforestation Specialist for Region I, to finalize the documents.

Transitions

I would like to introduce Elizabeth (Libby) Pansing, our first WPEF intern. Libby's official title is "Assistant to the Director." She is a graduate student in Integrative Biology at the University of Colorado Denver, and is actively involved in whitebark pine research. Libby started out last spring developing the WPEF Facebook page. She is now our website director and liaison to Webmeister Chuck Crouter, but will be working on other projects as well.

It is also my pleasure to welcome new board members Melissa Jenkins and Edith (Edie) Dooley. We thank Ron Mastrogiuseppe and long-time WPEF board member Kate Kendall, who are stepping down, for their dedication to the WPEF and contributions over the years. We hope that they will both continue to work with us in other capacities. ■

10th Anniversary Meeting Draws 100

Steve Arno

On September 16 and 17, 2011, upwards of 100 people gathered at the Draper Museum of Natural History in Cody, Wyoming, to share the latest knowledge of whitebark pine ecosystems. Curator Dr. Charles Preston welcomed us to the Draper Museum, which is a highlight of the impressive Buffalo Bill Historical Center. The first day was filled with a whitebark pine science and management workshop followed in the evening by a celebration of the 10th anniversary of the all-volunteer Whitebark Pine Ecosystem Foundation (WPEF), including a reception followed by some presentations aimed at a broader public audience. The second day featured a field trip to whitebark pine habitats along the spectacular Beartooth Highway south of Red Lodge, Montana.

In welcoming statements, Joe Alexander, Supervisor of the nearby Shoshone National Forest, emphasized that the Forest staff recognizes whitebark pine as an important resource gravely threatened by bark beetles and ultimately by climatic warming. Kent Houston, Shoshone N.F. soil scientist who shepherded local arrangements for the meeting, gave some historical perspective. He pointed out that more than a century ago Ernest Thompson Seton in his children's book *Biography*

of a Grizzly, set in Wyoming, incorporated whitebark pine into the story, although like some other early naturalists he called it "piñon."

Just a few of the notable presentations--with apologies for my inevitable oversights--included geographer Wally MacFarlane and wildlife advocate Louisa Willcox (see her article in this issue) who reported on innovative projects that engage the public in learning about whitebark pine and monitoring its status. Wally described outings conducted by Treefight (www.Treefight.org) that involve the public in whitebark pine research. He showed landscape photos from Ecoflight (www.Ecoflight.info) that display massive areas of pine beetle-killed whitebark pine, and explained how these photos are useful in gaining public and political support for whitebark restoration.

Amy Nicholas of the U.S. Fish and Wildlife Service explained and answered questions about whitebark's status as a candidate for listing under the Endangered Species Act. (See her article in this issue.) Peter Achuff, Brad Jones, and Michael Murray brought us up-to-date on Species at Risk listing and restoration efforts for whitebark and limber pines in British Columbia and Alberta.

Entomologist Jesse Logan (retired from the USFS Rocky Mountain Research Station) reviewed the history of mountain pine beetle outbreaks in whitebark pine and the conditions that favor them. He pointed out that a severe cold snap in October 2009 and the cooler-than-average winter of 2010-2011 seems to have slowed the current epidemic.

John Shaw, USFS Forest Inventory and Analysis, and Erin Shanahan, National Park Service, presented information about monitoring plots in whitebark pine stands and the mortality trends they are documenting. Montana State University professor Cathy Cripps and graduate student Erin Lonergan shared emerging knowledge of the critical relationships between whitebark pine and mycorrhizal fungi in the soil, and the latter's likely role in success of pine regeneration.

After the WPEF's 10th Birthday celebration, luckily an extra carrot/nut cake remained. On the second day's field trip this served as a surprise treat during a snowy late-morning stop atop the Beartooth Plateau. Among other field trip features, participants had a chance to compare mature whitebark and limber pine trees growing side-by-side at the 9000-foot overlook where the Beartooth Highway ascends above Rock Creek Canyon. A thousand feet higher, we trekked a quarter mile across alpine tundra to a tree line community. Here, in the wind-shelter of stunted whitebark pines, University of Colorado-Denver graduate students Jill Pyatt, Sarah Blakeslee and Elizabeth Pansing explained their studies of how regeneration and survival of these hardy conifers are influenced by microclimate. We could all wonder if whitebark pine will be colonizing the alpine tundra if warmer summers become the norm. However, on this mid-September afternoon as an interesting and scenic field trip concluded, we marched back across the wind-chilled tundra sensing a prelude to winter. ■

Beyond the Classroom: UM Students Attend WPEF Conference

Andrew J. Larson and Natalie Dawson
College of Forestry and Conservation
University of Montana, Missoula

Twenty-five students from The University of Montana's Wilderness and Civilization program participated in the 2011 Whitebark Pine Ecosystem Foundation (WPEF) Science and Management Workshop in Cody, WY. The Wilderness and Civilization program is a year-long, interdisciplinary program focused on the study of wilderness and natural resources throughout the West. The students spend thirty days in the field learning about natural landscapes, and human roles in modifying, conserving, or restoring them. As part of the program, students take classes in a variety of subjects—e.g., Literature, Ecology, Native American Studies, and Environmental Policy—and supplement their campus-based learning with weekly field trips. Upon completion of the program, students receive a minor in Wilderness Studies, going on to become our next generation of scientists, researchers, advocates, and engaged citizens.

Our trip to Cody to attend the WPEF Science and Management Workshop was undertaken as part of the Conservation Ecology (Larson) and Wilderness and Civilization (Dawson) courses. The objectives for the trip were to introduce some basic ecological concepts and examine the conservation status and restoration strategies for the threatened whitebark ecosystem.

The whitebark pine ecosystem serves as an excellent model for several ecological concepts. The relationship between Clark's nutcracker and whitebark pine—seeds as a food source for the nutcracker in exchange for seed dispersal and regeneration for the pine—is a classic example of a mutualistic interaction between species. The varied fire regimes of whitebark pine forests and the current mountain pine beetle outbreak provide a tractable, yet nuanced, introduction to the concepts of ecosystem disturbance and succession. The scramble by Clark's nutcracker, red squirrels, and black and grizzly bears to harvest and consume (or store) energy-rich whitebark pine seeds illustrates competitive interactions among species, as well as energy flow through food webs. Several of the workshop presenters covered these phenomena in detail, much to our delight! In fact, the workshop presentations provided more ecological information than we expected: many of the students indicated in their reports that learning about facilitative effects of whitebark pine on tree island formation at timberline and interactions between whitebark pine and mycorrhizal fungi were scientific highlights of the trip.

The students' field trip reports support an important conclusion about the WPEF: the workshop was effective as an outreach and education event. Because the workshop occurred early in our semester, the students came with minimal preparation—just one brief lecture and a single reading assignment. By the end of the workshop the students all understood the basic ecology of and threats to whitebark pine ecosystems, as

well as their social and ecological importance. Visiting actual research sites on the Beartooth Plateau field trip, with accompanying graduate student presentations and the ensuing give-and-take discussion among research scientists and managers, reinforced ecological concepts introduced during the Friday presentations in Cody. Many students also commented on the dedication and passion WPEF members, from graduate students to managers and scientists. Part of the effectiveness of the workshop is undoubtedly attributable to the enthusiasm of the presenters: technical details of ecosystem science and management are more palatable when presented by individuals who obviously care deeply about the ecosystem!

Many students also commented on the ethical aspects of whitebark pine ecosystem conservation and restoration, especially with respect to wilderness management. Their comments remind us that conserving whitebark pine ecosystems is not only a technical and scientific challenge; it has significant social and ethical dimensions as well. For example, several students raised questions about when and where the human-caused threats to whitebark pine ecosystems—fire suppression, climate change and blister rust—constitute valid justification to undertake even further human modifications to the ecosystem in the name of conservation and restoration. As the scope of WPEF activities increase in coming years these types of difficult ethical questions and debates will likely become more prominent.

The workshop provided a unique educational outcome that is not readily achieved in the classroom. Because workshop presenters shared original results from ongoing research as well as novel restoration strategies, the students *experienced* the creativity and excitement, as well as the uncertainty and debate that define the cutting edge of ecosystem science and management. There is no substitute for the rapid-fire questions that experts pose to each other after each presentation to underscore the boundaries of current knowledge and practice. Even the unspoken collective response of the audience was educational: which research findings or restoration proposals provoke gasps of surprise and which provoke growls of skepticism? These aspects of the meeting highlight important and controversial ideas in a way that simply cannot be replicated in the classroom. We are already looking forward to the 2012 meeting in Kimberly, British Columbia! ■

High Five Proceedings Now Available

Many high-elevation five-needle pines are rapidly declining throughout North America. The six species--whitebark (*Pinus albicaulis* Engelm.), limber (*P. flexilis* James), southwestern white (*P. strobiformis* Engelm.), foxtail (*P. balfouriana* Grev. & Balf.), Great Basin bristlecone (*P. longaeva* D.K. Bailey), and Rocky Mountain bristlecone pine (*P. aristata* Engelm.)--are of great ecological and symbolic importance in the U.S. and Canada. The International "High Five" Symposium, was held June 28-30, 2010, in Missoula, Montana to: (1) bring together scientists, managers, and concerned citizens to exchange information on the ecology, threats, and management of these pines; 2) learn about the threats and current status of pine populations; (3) describe efforts to mitigate threats through restoration techniques and action plans; and, (4) build a foundation for the synthesis of research efforts and management approaches. The proceedings of this comprehensive symposium are now available on the internet: http://www.fs.fed.us/rm/pubs/rmrs_p063.html and in print. The printed proceedings can be obtained by writing to Publications Distribution, Rocky Mountain Research Station, USDA Forest Service, 240 W. Prospect Rd., Fort Collins, CO 80526. The citation is:

Keane, Robert E.; Tomback, Diana F.; Murray, Michael P.; and Smith, Cyndi M., eds. 2011. **The future of high-elevation, five-needle white pines in Western North America: Proceedings of the High Five Symposium.** 28-30 June 2010; Missoula, MT. Proceedings RMRS-P-63. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 376 p.

These proceedings present reports on some of the exciting and interesting studies going on in high-elevation pine research in the form of abstracts, extended abstracts, papers, and plenary papers in the areas of ecology, disturbance dynamics, genetics, climate change, and restoration techniques. ■

Calling All Photographers:

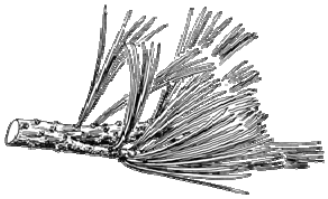
Announcing WPEF's Calendar Photo Contest!

Stop hoarding your best whitebark photos in middens on your computer and cache them on the internet! We know all you whitebark pine lovers and stewards have been taking beautiful pictures of whitebark pines over the years. The foundation is requesting photo submissions to create a 2013 WPEF Whitebark Pine calendar (sorry Board Of Directors- you're ineligible!). Photos of any component of whitebark pine ecosystems from wildflowers amongst whitebarks to Clark's nutcrackers to mountain landscapes are welcome. However, there must be a recognizable whitebark pine (or part of one) in the picture. After the contest closes we will post all submissions on our website and have members vote for their favorites. The 13 pictures with the most votes will be used in our official WPEF 2013 calendar, which will be available fall 2012.The calendar will be available for a modest fee, and will also be used as an incentive gift to new members joining the foundation. Thus by submitting photos, existing WPEF members will be helping the foundation grow!

Please send high quality images (6 megapixel minimum) along with the photographers name, picture location, date and a small description (50-75 words), to Libby Pansing at Elizabeth.pansing@ucdenver.edu. Submission deadline is March 1, 2012. For more information, please visit our website: www.whitebarkfound.org ■

"Needles of five, keep it alive!"

Limber & Whitebark Pine Handouts Available Online



The Foundation's website offers two handouts that ask visitors to protect whitebark and limber pines. Entitled "Needles of Five, Keep It Alive", these informative, black-and-white one-pagers can be given to campers, hunters, firewood cutters, and other visitors to show them what the pines' foliage looks like and explain why protecting these trees is important. Download the handouts at http://whitebarkfound.org/resources.html. ■

ELECTION NEWS: Nominations Wanted

Cyndi Smith, Associate Director

At the fall 2011 Board of Directors meeting in Cody, Wyoming, we welcomed Melissa Jenkins and Edie Dooley as new general board members, and returning board members Ward McCaughey (Treasurer) and Cyndi Smith (Associate Director), who were re-elected to their executive committee positions. We thank outgoing board members Carl Fiedler and Ron Mastrogiuseppe for their past contributions to the Foundation. Ron has agreed to join the Education Committee, and his assistance is appreciated.

As per our election cycle, we are now seeking nominations for the following five positions, which will be voted for in April 2012:

- Membership / Outreach Coordinator
- Treasurer
- General Board Member
- General Board Member
- General Board Member

We are seeking a new Treasurer, as Ward McCaughey had resigned his position last year but agreed to stand for one more year when we could not find a new nominee. A limiting factor is that the Treasurer needs to reside in the Missoula area, due to banking requirements. **If you know of anyone who might be interested, please nominate them or contact me for more information**.

This is an exciting time for the WPEF, which has just celebrated its 10th anniversary. We have undertaken strategic planning for the next decade and there are many opportunities for board members to play a leading role in re-vitalizing many of our existing projects and taking on new challenges for the foundation.

Please check the website www.whitebarkfound.org to download the nomination form, which includes a description of the duties of each position, and eligibility rules. Nominations must be postmarked or dated no later than February 1, 2012. If you have any questions, please contact me at cyndi.smith9@gmail.com.

Elections will be conducted by sending out a pre-stamped and pre-addressed ballot card to each member. This method of voting has brought our participation rate up to an average of 62% of members voting in the last two years, from a low of only 14% in 2008! ■

WPEF Membership Growing

The Whitebark Pine Ecosystem Foundation had 188 members as of October, 2011. Our total membership has fluctuated between about 150 and 180 for the past couple years as some members do not renew and others join. The current membership total is the largest in our history. I am optimistic that we will have 200 members by the end of the calendar year.

The Board of Directors places a high priority in recruiting and retaining foundation members. A substantial membership base attests to the credibility of our organization when we apply for grants to aid in our mission. A large and diverse membership also allows for a wide range of ideas and information to be shared, which aids our mission of restoration and education.

Foundation members are remarkably loyal. On our tenth anniversary we still have 30 "charter" members—those who joined during our first year. Also, we typically get an annual renewal rate in excess of 80 percent. Most of our members are on the rolls as Whitebark level ($35), although about 40 members enroll at higher levels --Nutcracker, Institutional, and Grizzly memberships—which contributes further to our mission. We have 10 Student members who are able to join at a reduced annual rate.

New members at the Nutcracker, Institutional, and Grizzly levels will soon receive a beautiful wall calendar featuring photos of whitebark pine and other high elevation ecosystems. The first edition of the calendar has photos provided by WPEF board members.

The foundation's web site at www.whitebarkfound.org has a complete discussion of the different membership levels and forms for initial membership and renewal. Joining or renewing by using ***PayPal*** at the web site is a quick and convenient way to maintain your membership. Questions, comments, or suggestions about membership in our foundation can be directed to the Membership and Outreach Coordinator Bryan Donner, at (406) 758-3508 or donnermt@yahoo.com. Please put "WPEF" or "Whitebark" in the subject line of your e-mail. ■

Interview with Melissa Jenkins

Editor: When did you first "get acquainted" with whitebark pine?

Jenkins: My first experience was planting whitebark pine seedlings on the Targhee National Forest (NF). I purchased whitebark seed from the Gallatin NF in 1991 to grow seedlings for planting in the 1988 North Fork Fire near the border of Yellowstone National Park (NP). A few years later we had a huge whitebark cone crop on the Targhee. I cooperated with the local electric company to

collect whitebark cones with a bucket truck that they donated as a community service project. We collected over 80 lbsof seed with a germination rate of 85 percent. A germination rate that high was unheard of at the time; our planting program, and my interest in whitebark, were off and running!

Editor: What led you to initiate efforts to protect and restore whitebark pine?
Jenkins: Initially, we knew that a lot of whitebark pine had been lost in the 1988 Yellowstone fires and wanted to help restore it. As I began to learn about the amazing ecosystem that whitebark pine represents, it was easy to develop a passion for the species. One cannot help but admire a tree with such tenacity and longevity that thrives in such unique and wild places.

Editor: Please give us a brief synopsis of your whitebark pine projects over the years.
Jenkins: When I originally got involved with whitebark pine planting in the early 1990's, we planted a small number of acres every other year or so. It is encouraging to see that many national forests, including the Flathead NF where I am currently working, are planting increasing numbers of seedlings annually. Since the mid-1990's I have been involved with the planning, contracting and implementation of a wide variety of whitebark pine projects including: prescribed burning to promote its regeneration; silvicultural treatments to reduce competing vegetation; establishment of permanent monitoring plots; identification of "plus" trees for the genetic rust resistance breeding program; protection of high-value whitebark pine with insecticide or pheromones; and cone collection.

In 2001, I became the first Chair of the Greater Yellowstone Coordinating Committee Whitebark Pine Subcommittee. Recognizing the need for an ecosystem-wide restoration strategy, I wrote the *Greater Yellowstone Ecosystem Whitebark Pine Restoration Guidelines* in 2005. In 2009, I began working with the Missoula Technology and Development Center to develop equipment that can be taken into the backcountry to protect remote whitebark pine from bark beetle attack with insecticide. We successfully used that equipment to spray remote, high-value whitebark pine in 2010 and 2011. In 2011, I became the first chair of the newly formed Northern Continental Divide Ecosystem Whitebark Pine Committee.

I am continually amazed at the dedication of those individuals who have been championing the whitebark pine cause since the beginning, and am encouraged by the passion and energy of those who are just becoming involved.

Editor: You have extensive experience with whitebark pine stands in both the Northern Continental Divide and the Greater Yellowstone ecosystems. Please compare or contrast the conservation challenges for whitebark in these regions.
Jenkins: The major differences that I see in the two ecosystems are:

- The Greater Yellowstone Ecosystem (GYE) has a group that has been in place to coordinate whitebark pine restoration and information sharing since 2001. They have developed a restoration and protection strategy to guide their efforts. The Northern Continental Divide Ecosystem (NCDE) began organizing a group in 2010 that is just starting to work on some of the same type of efforts.
- In the NCDE, blister rust has had a much more profound effect. There are fewer trees and higher levels of rust infection than in the GYE. This makes it easier to identify trees with potential rust resistance, but chances of sufficient natural regeneration establishing in disturbed areas is low.
- The GYE has higher levels of recent bark beetle mortality. More effort is needed to protect high value trees such as those with potential rust resistance ("plus" trees). The ecosystem will have to adapt to a rapid change.
- The GYE has much heavier and more frequent cone crops than the NCDE and in general has much better access to cone collection locations. Consequently, the GYE has more collected seed in storage and is further progressed with the genetic rust screening for their seed zone. It also means that the GYE has more of a connection between whitebark and grizzly bear issues because bears in the GYE are more likely to use whitebark pine as a food source.
- The GYE has an ecosystem-wide consistent whitebark monitoring program with permanent plots. The NCDE has many monitoring efforts that are specific to whitebark, but they are not consistent over the entire ecosystem.

There are also many similarities in the challenges that the two ecosystems face. I would say that the primary one is difficulty in securing funding for the planning and implementation of restoration projects; especially the planning portion. Another challenge is the lack of personnel that have the knowledge, experience, and time necessary to plan and implement restoration projects on some NF and NP units. Both of the ecosystems are working through the question of how, or even if, active restoration can play a role within designated wilderness. Also both ecosystems face uncertainty in how to tailor restoration efforts in light of climate change predictions.

Editor: Describe your most memorable whitebark pine experience.
Jenkins: There have been so many memorable experiences, some positive some negative. It is quite a thrill to be lighting fire with a drip torch while groups of subalpine fir explode into flames around you. It was profoundly sad to see a magnificent "plus" tree that had been identified too late in the year to be sprayed with carbaryl, cage the cones and then find it dead from bark beetles when we returned to collect the cones. I treasure the times I have spent hiking in breath-taking, beautiful places, and the quiet moments I spent under a massive

whitebark pine by an alpine lake in Glacier NP.….you would think my most memorable experience would be something like that. But believe it or not, my most memorable experience is from the Lolo NF in 2010 when I saw a little conelet growing on a grafted seedling in the first whitebark pine seed orchard. How strange to have my most memorable experience with whitebark pine, icon of wild places, be standing amongst a group of people looking at an unnatural, humanly created graft, inside a 10 foot tall chain link fence. But to me, that conelet represented both the culmination of years of hard work by many people who share my passion, and the future of whitebark pine restoration. It represented how far we have come. It represented hope for the future of whitebark pine. ■

Whitebark Pine and the Endangered Species Act

Amy Nicholas, U.S. Fish and Wildlife Service
Wyoming Field Office

On July 19, 2011, the U.S. Fish and Wildlife Service (FWS) determined that listing whitebark pine (*Pinus albicaulis*) as threatened or endangered under the Endangered Species Act (ESA) is warranted but precluded by other higher priority listing actions (Fed. Register, Vol. 76; p. 42631). The FWS made the determination in response to a petition filed on December 9, 2008, by the Natural Resources Defense Council (NRDC). The FWS's review of whitebark pine occurred in two stages as outlined in the ESA. An initial review, known as a 90-day finding, completed on July 20, 2010, concluded that the petition contained substantial information supporting the need for a full examination of whitebark pine's status. Thereafter, the FWS completed a comprehensive review known as a 12-month finding and determined that there is sufficient scientific and commercial data to propose listing the species throughout its entire range.

The FWS found major threats to whitebark pine include habitat loss and mortality from white pine blister rust, mountain pine beetle, catastrophic fire and fire suppression, environmental effects resulting from climate change, and the inadequacy of existing regulatory mechanisms. Whitebark pine is experiencing an overall long-term pattern of decline, even in areas originally thought to be mostly immune from the above threats. Recent predictions indicate a continuing downward trend within the majority of its range. While individual trees may persist, given current trends the FWS anticipates whitebark pine forests will likely become extirpated and their ecosystem functions will be lost in the foreseeable future. On a landscape scale, the species appears to be in danger of extinction, potentially within as few as two to three generations (approximately 120-180 years).

Despite its determination that protection under the ESA is warranted, the FWS is precluded from beginning work immediately on a listing proposal because the agency's limited resources must be devoted to other, higher priority listing actions. In other words, limited resources are currently directed at species considered to be at higher risk. As a result, following publication of the FWS's 12-month finding, whitebark pine was designated as a candidate species for listing. This candidate designation included a listing priority number of 2, which means that the threats to whitebark pine are considered imminent and of high magnitude. Listing priority numbers for candidate species range from 1 to 12, with species designated with 1 as the highest priority for future listing. As a candidate species, the status of whitebark pine will be reviewed annually. If the FWS proposes the whitebark pine for listing in the future, the public will have an opportunity to comment.

Candidate species receive no statutory protection under the ESA. However, the candidate status promotes cooperative conservation efforts for the species. The U.S. Forest Service and other partners have already made important strides in understanding the ecology of white pine blister rust and mountain pine beetle. The majority of whitebark pine occurs on national forest lands, and the Forest Service has implemented important conservation actions, such as developing and planting blister rust-resistant seedlings. Importantly, research on the propagation of rust-resistant whitebark pine seeds and seedlings is underway and strategic conservation plans are being developed. The FWS will continue to work with the U.S. Forest Service and other partners to develop strategies to address the threats. ■

Collecting Cones in an Active Fire

Karl Anderson, Culturist, Flathead National Forest

During the late spring of 2011, personnel on the Flathead National Forest (NF) began to assess the whitebark pine (WBP) cone crop. The Flathead NF has thirteen highly valued sites where we have identified phenotypically rust resistant trees that we use for cone collection. Initial assessments indicated that we could expect a bumper crop that was unprecedented in our area. We know from cone scar research that there has not been a masting event like this in our area for over 20 years. We began to plan cone collection efforts, building cages and finalizing tree climbing contract details.

On July 21st, trees in the Puzzle Hills area of the Hungry Horse Ranger District were successfully caged to protect them from predation as part of the forest-wide collection effort. A total of six "plus" trees and ten operational trees were caged, making it one of our biggest cone collection sites. The trees had an average of 45 cones per tree, which exceeded any past collections on the Flathead. Forest personnel were understandably excited about this opportunity. The anticipated forest-wide collections would meet most of our tree improvement program needs, as well as building an operational seed bank for future outplanting as part of an overall Flathead NF whitebark pine restoration effort. Cone collections were planned for mid-September.

On September 9th, four days before the arrival of the climbing contractor, a 35 acre lightning fire was detected in the drainage directly adjacent to the Puzzle Hills WBP location. After aerial reconnaissance by the

district ranger and fire specialist, it was determined that the area would be closed to public use and the Puzzle Fire would be managed as a wildland fire with multiple objectives. The district fuels specialist was assigned as the Puzzle Fire Incident Commander (IC). The district culturist immediately informed the ranger and IC of the significant value of the Puzzle Hills whitebark pine location, and the contract for cone collection that would be compromised if the contractor could not access the site.

When the climbing contract personnel arrived to start work on September 12th, a meeting was held to inform them of the access issues created by the fire. Accessing this site that was closed to the public because of a wildfire was a safety concern that would not be taken lightly. A total of five contract climbing personnel, and ten Flathead NF employees attended the meeting. The IC informed the group that the fire had grown to 2000+ acres, and that another one acre fire was spotted southwest of the collection location in the most recent reconnaissance flight.

Luck being on our side, there was a potential weather window available the next day, September 13th. Concern was high for rapid fire spread later in the week when a predicted weather front with high winds would potentially cause the Puzzle Hills whitebark location to be overrun. The 13th was the only day we had to get in, get the cones collected, and get out. While the need to collect cones from these highly valued WBP trees was recognized, the primary focus was providing safety for everyone. It was determined that the operation would continue with assistance from the district fire organization including posted lookouts and a fire personnel contact on-the-ground with the collectors. It was made very clear that if fire activity increased or weather changed for the worse, fire personnel would make the call on when to leave the site and there would be no questions. We would leave immediately.

On September 13th at 0530 hours, the contract climbers and Forest Service personnel met at the Hungry Horse District Office to begin what would be an adventurous morning. We started early knowing fire activity would be slow and would allow us time to get in and out before fire activity increased in the afternoon. All personnel wore Nomex fire resistant clothing and carried fire shelters. We arrived on location at 0645 and prepared for a 20 minute hike in to the caged trees. Before leaving, it was reiterated that safety was the primary objective and if fire personnel determined it was time to leave, we would leave without question.

As the group walked to the site, the early morning light filtered through the smoke that was all around us. It was an eerie feeling. The contractor was heard saying, "Wow, we have never done anything like this before!". Of course, none of us had done anything like this before. We were comfortable with the situation though, because we knew the fire personnel "had our backs" with two posted lookouts and one on-the-ground contact in constant communication. A total of twelve Forest employees, including the three from fire, were involved with the collection effort. It went off without a hitch. It had been decided earlier to have the contractor also collect 30 pieces of scion (cone bearing branches from the top of the tree) from each of the three "plus" trees in the genetic rust screening program while they were climbing. This was done to preserve the genetics in case the trees were lost to the fire. All of the work was completed by 1130 and the group safely hiked back to the vehicles.

Fortunately, cool, wet weather limited additional fire growth to ultimately 2,500 acres and the whitebark pine trees were never compromised. Some great things came out of the unique experience that the group shared that day. Although the "plus" trees were safe, the scion that had been collected and sent to Coeur d'Alene Nursery was grafted onto root stock. Grafting actively growing material, or "hot grafting", had not been tried with whitebark pine before. So far, all of the grafts appear to be successful which may lead to less expensive and time consuming collection of whitebark scion in the future. The collection could not have occurred without support from the fire personnel and the flexibility of the contractor and silviculture crew. It was extremely satisfying for everyone involved to work together to safely accomplish our mission under potentially dangerous working conditions. It was an experience that none of us will soon forget. ■

Climbing Whitebark Pines

Brian Krott, BLM Forestry Technician
Dillon, Montana

As a Forestry Technician with the Bureau of Land Management I have gained experience working with whitebark pine. In the summer of 2010 the Dillon, MT, field office launched its effort to restore whitebark pine. I helped locate whitebark on BLM land and design protocol for selecting trees to collect cones and protect trees with Verbenone.

Initially our forestry program contracted climbers to cage and collect cones for us. Then this past summer some of my co-workers and I were authorized to take a Tree Climbing Certification Class conducted by the Forest Service in Missoula. This gave me the opportunity to climb trees we had previously selected and to cage and harvest cones. Climbing whitebark pines is a unique experience. Having been on both sides of the collection process now, I have a whole new appreciation for what it takes to install a cage on cones located on the top leaders of the tree.

Whitebark comes in many shapes, heights, and sizes which makes for some challenging climbs, each tree requiring a different approach. Some trees make it easy by providing ample side branches for foot holds. In others you need to throw a line into the tree and hoist yourself into the canopy. After getting into a strategic position high in the canopy, you figure out how to secure yourself in the tree. You rely on equipment, training, and the strength of the tree.

There is no such thing as being really comfortable in the top of a tree, it is a physically and mentally demanding task. The climber must constantly focus on safety as well as strategizing how to get the job done. However, the more time you spend climbing whitebarks the more you improve technique and pick up on different nuances that make the job easier and more efficient.

Getting into the tree is just part of the experience. Caging cones and collecting cages is what you spend the other half of your time doing. Caging is the more demanding task. Individual whitebarks can have brittle or flexible branches. Flexible branches are a lot more forgiving for installing cages. Having a climbing partner in the tree can be helpful. After you are comfortable with a climbing partner and develop a system, caging and collecting can be more efficient. Having an extra set of hands or another person caging or removing cages speeds up the process and reduces your exposure time in the tree.

I have found that climbing whitebark pine trees is an amazing personal experience. Part of the reward lies in accomplishing the difficult task of obtaining seeds that are essential for restoration of this special tree. ■

High Cone Years Give Limber Pine "the Edge"

Vernon Peters and Matt Gelderman
Department of Biology, The King's University College, Edmonton, Alberta

Introduction

Amongst North American conifers, extreme fluctuations in cone production from one year to the next, is a way of life. Many members of this diverse cone-bearing taxon, synchronously produce high cone crops across wide geographic areas in what are known as mast years, and typically produce few to moderate numbers of cones in most years. For trees important to wildlife like the limber pine and whitebark pine, interannual variation in seed production undoubtedly affects the population dynamics of seed predators and seed dispersers as well as a variety of community-level interactions. At longer, evolutionary time scales, these interactions have driven the very traits that cones possess (Benkman 1995), the degree of interannual variation in seed production, and the strength of either beneficial or negative effects that wildlife have on the regeneration dynamics of the tree.

High seed years in limber pine have been reported to occur intermittently every 2–4 years (Langor 2007); however, no scientific studies have investigated their geographic synchrony, or the variability in interannual cone production. For a species that is rapidly declining due to disease, insects, and fire suppression, even minor variations in annual seed production may be critical to avoiding heavy cone losses to squirrels, and attracting the critical dispersal agent, the Clark's nutcracker.

We quantified cone production in low versus high white pine blister rust (WPBR) infested landscapes at the northern limits of limber pine distribution in North America. Populations at the edge of a species distribution warrant focused study because the strength of selection pressures are known to engender greater variation in population characteristics (Tomback et al. 2005). Our objective was to quantify the degree of interannual variability in cone production of limber pine, to determine whether common mast years were identifiable in all studied populations, and to determine whether cone production depended on the severity of infection in the two landscapes.

Methods

Two distinct geographical regions of the Montane Ecoregion in Alberta, Canada, were studied: 1) the southern Porcupine Hills formation (lat. 49.60°N, long 114.20°W), a region with high WPBR severity historically, and stands of either limber pine or limber pine–Douglas fir mixtures, and 2) the Kootenay Plains of the Rocky Mountains (lat 52.00°N, long. 116.50°W), a region with low WPBR severity, and both open stands of limber pine, or closed stands of limber pine mixed with either white spruce or lodgepole pine.

Figure 1: An unusually large cluster of cones in the 2010 mast year (photo by Matt Gelderman)

We sampled eight and nine forest stands in the high- and low-WPBR study areas, respectively, and recorded cones on a total of 40 trees of cone bearing size per stand. Trees that had lost most of their needles and appeared close to death were not chosen. Ovulate cone counts were recorded annually (2008 – 2010; n = 440, 679, and 678 trees respectively) with binoculars (7 – 10x zoom), between June 15 – July 10th, a period when maturing green cones were highly visible (**Fig. 1**), and cone predation had not yet occurred.

To compare interannual variability of cone production in limber pine to other masting species, coefficient of variation (CV) values were calculated individually for the 11 stands where cone crops were recorded for the three year period (2008 – 2010). CV values take the average cone production per year, and divide it by the variability between years (i.e. standard deviation). A single CV value from these 440 trees was

also calculated for this period. Analysis of variance was used to test whether interannual variability in cone production occurred between (1) years and (2) low vs. high rust infection levels.

Results and Discussion

Significant interannual variability appears to characterize the cone crops of northern limber pine populations. We observed 3 – 5 times as many cones in 2010 as produced in 2009 and 2008, respectively (**Fig. 2)**. Simultaneously, the percent of cone-bearing trees increased significantly to 95 % in 2010 from 56 % in 2008, and 66 % in 2009. Reproduction in limber pine appears to fit common definitions of the "masting" habit, since most trees produced many cones in 2010, and 2010 was the highest cone year in all 17 stands, suggesting regional synchrony amongst sites 350 km apart. The overall CV value for 2008 – 2010 was 1.93 (n = 440 trees), and ranged between 1.32 – 2.42 for individual stands (n = 11 stands). Limber pine's CV values fall within the highest 10–15% of datasets reviewing supra-annual seed production amongst species (Herrera et al. 1998). Our estimate of limber pine's CV value may be less accurate than those reported for other species due to our shorter duration of study (three years vs. four or more years of recorded seed production).

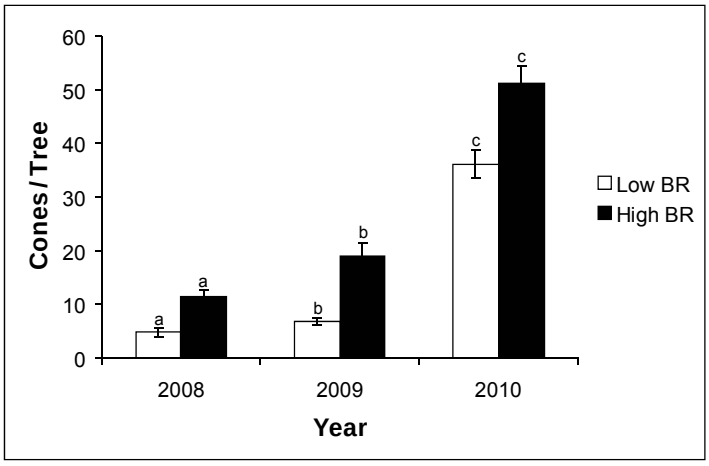


Figure 2: Annual mean cone production (mean +/- 1 s.e, n = 17 stands) within each study area. Different letters above bars denote significant differences between years).

Marked inter-annual variability has been linked to seed dispersal strategies, with the greatest variability observed in species dispersed by abiotic means (i.e. wind, or gravity). Limber pine showed greater inter-annual variability than is typically observed in many species dispersed by scatter hoarders (i.e. seed-caching birds or rodents), suggesting that escape from seed predators has contributed to its high degree of interannual variability. Limber pine is subject to 80 % cone losses to red squirrels in low cone years (Peters and Vandervalk 2009); leaving only 1 – 3 cones on average for seed dispersers in 2008 and 2009 (V. Peters, personal observation). We expect that lower levels of cone predation occurred in the 2010 mast year; however, no prior study has tested whether seed predator escape varies interannually, when a masting species declines. Greater cone escape in mast years may be critical for attracting the scatter-hoarding mutualist, the Clark's nutcracker , as has been observed at regional levels in whitebark pine ecosystems (McKinney et al. 2009).

The importance of high seed crops in limber pine to providing regeneration opportunities will likely depend on a variety of community-level interactions, in these disease-altered ecosystems. Although WPBR appears to reduce the cone-producing potential of a stand through adult mortality, exceptions do occur, as cone production was 69.8 % greater in our high WPBR study area than our low WPBR study area (**Fig. 2)**. Secondly, the dependence of red squirrel populations on limber pine cone production, may determine whether interannual escape occurs through alternately starving and satiating squirrels. Thirdly, community wide synchrony in masting amongst trees is considered critical for cone escape; however, this did not occur consistently during our study period (white spruce, douglas fir, and limber pine had high cone crops in 2007 but only limber pine masted in 2010; V. Peters pers. obs.). The nature and strength of these interactions will be investigated further in future studies at the northern limits of limber pine.

Acknowledgements

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Citizen Science: Transformational Power of Whitebark Pine Research

Louisa Willcox, Sr. Wildlife Advocate
Natural Resources Defense Council

Over the past five years, I've been involved in an exciting adventure that relies on "citizen scientists" to collect field data on the condition of whitebark pine forests. However, it has been far more than a data collection project. The experience of being out in whitebark pine ecosystems has fundamentally changed the perspectives of citizens about their connections to the land and to each other. For many, the impact of citizen science has been nothing short of transformational.

Examining mountain pine beetle activity.

Citizen science has ancient roots, predating the development of modern scientific observational techniques. But it is more relevant today than ever: with whitebark ecosystems changing so rapidly, outstripping conventional research approaches, citizens have an increasingly important role in helping scientists document the ongoing drama. Citizen science has also provided a way to ground-truth assessments Based on aerial surveys, modeling, and other indirect methods.

NRDC's citizen science effort began after an expedition with Dr. Jesse Logan and Wally Macfarlane to assess whitebark pine condition in 2006. We conducted our first citizen science training program in 2008. The enthusiastic response prompted us to expand our work beyond whitebark to measure the response of Clark's nutcrackers and squirrels to healthy and damaged whitebark pine stands. The data collected is being used by Taza Schaming of Cornell University in her work on nutcracker behavior.

This year, NRDC has been working with Adventurers for Science and Conservation to assess grizzly bear presence and the health of whitebark pine in the Centennial Mountains, a key ecological corridor between Yellowstone and central Idaho wilderness.

I will leave it up to the citizens to tell their own stories of how this work has affected them.

Bruce Gordon, Pilot, EcoFlight:

The work that I've done on whitebark pine has been a game-changer for me. To fly over forests that were green a few years ago, and to watch them turn red and then grey—well, it's like a cancer on the forest, spreading so quickly. It's so powerful visually. This work has been a wake-up call, a jolt, an exclamation point about climate change.

The other thing that I've really been impressed with is the dedication, intellect, imagination and fortitude of the citizen scientists I work with, who volunteered their time collecting data and writing about the findings that were necessary to convince politicians and people that something major is happening and that we need to do something about it.

Colin Peacock, Citizen Scientist, Educator:

At the first citizen science conference in Dubois, I got trained and went out with inspiring people like Jesse Logan and Wally MacFarlane and learned a ton. It was incredible to travel through the Yellowstone Ecosystem with Jesse and experience through him the red, dead trees everywhere we went….

I saw forests that had been around for about 1,000 years old, but everything, everything, the entire canopy was wiped out in the space of about three years. We were able to document this with Round River (http://roundriver.org/) students. It's a scary thing, and humbling watching ecosystems slowly being snuffed out and the environmental impact that we have caused. It makes me wonder what to do with my life. I'm not giving up.

Dena Adler, Citizen Scientist, Educator:

Whitebark pine and citizen science has profoundly affected my life. Through the lens of science, I developed a sense of place in the Greater Yellowstone Ecosystem, and a sense of climate change as it is occurring in a place. Growing up in New York, you don't see climate change, but when I went to Wyoming's Wind Rivers year after year, hiking the same trails, going to the same stand of trees, I began to see the red spreading. We kept finding what we thought to be green trees, and looking closer, we saw that beetles had found them already. It makes you feel like you're part of the battle. If you find a green healthy tree, it's a victory. I am taking what I've learned in the field, working now in the climate

Dena Adler taking aerial photos. (photo by Louisa Willcox)

change policy arena, reaching out to people and connecting them to what is going on out on the ground.

David Gonzales, Director,Treefight:

I started into this work because I began noticing all of these old trees were dying. I wanted to make a film, and that turned out to be an effort to protect the whitebark pine trees that are left through the application of verbenone. The whole idea has taken over my life despite the fact that the situation is depressing and possibly futile. But we did get over 100 people out in the field this year, and I know we have raised a lot of public awareness.

It's so hard to watch these trees turn red. It's like the trees are screaming at you "bright red", delivering their final blood-curdling shout to the world, saying that what's happening to me is what is going to happen to you, because we are all on the same thermometer as these trees.

This work has given me a new purpose and it's ruined my life at the same time.

Gregg Treinish, Director, Adventurers and Scientists for Conservation:

In my expeditions in the backcountry, I consistently had a selfish feeling. I felt like I needed to do more by way of public service. I shared my feelings among fellow hikers, and there were other people who felt the same way that we wanted to give back if we had the tools. We've got some now.In terms of our work this summer on grizzly bears and whitebark pine, we've gotten a great response very quickly. People have been really inspired by getting out in the field and seeing grizzly bear habitat on the ground.

Capri Gillam, Citizen Scientist, World Traveler:

As soon as I found out about this citizen science work, I wanted to get involved – and did. This kind of work gets you in touch with nature, and even if you are not seeing bear sign, you are paying close attention and realizing that everything is connected. It's interesting in these sorts of groups that everyone has a special skill. You need a diversity of skill when you're doing these kinds of experiments. And there is always something to be learned no matter how skilled you are.

Jane Pargiter, Pilot, EcoFlight:

Why I have been so passionate about the work on whitebark pine is because of the symbiotic relationship of the whitebark pine, ground squirrels, the Clark nutcracker and of course our wonderful grizzly bear. This is nature at its most miraculous and is just so incredibly efficient; it is beneficial for all species involved. For EcoFlight to be able to try to help sustain this miracle of life for our children and grandchildren and the legacy of all creatures is very important. It also means so much on a spiritual and heart level, keeping the essence of our wild places and creatures wild. ■

Monitoring White Pine in National Parks

Shawn T. McKinney and Thomas J. Rodhouse
National Park Service, Inventory and Monitoring

Several networks within the National Park Service Inventory and Monitoring Program jointly developed a protocol for long-term monitoring of white pine communities. The Klamath (KLMN), Sierra Nevada (SIEN), and Upper Columbia Basin (UCBN) networks began development of this collaborative project early in 2010. This past summer (2011), plot establishment and field sampling began in the SIEN and UCBN, with field implementation planned for the KLMN in 2012. The networks measure the same core set of variables (see below), share field crews and training whenever possible, use the same database, and will conduct region-level trend analyses at four year intervals. In the KLMN, whitebark pine (*Pinus albicaulis*) is monitored in Crater Lake and Lassen Volcanic National Parks. The SIEN monitors whitebark pine in Yosemite, Sequoia, and Kings Canyon National Parks, and foxtail pine (*P. balfouriana*) in Sequoia and Kings Canyon. The UCBN monitors limber pine (*P flexilis*) in Craters of the Moon National Monument and Preserve (Figure 1).

Approach

Vegetation maps in a GIS serve as the base layer to develop sampling frames from which plot locations are drawn. We use the Generalized Random Tessellation Stratified algorithm (Stevens and Olson 2004) to select a spatially-balanced sample of plot locations. This approach is important to monitoring in these large landscapes because it allows one to make statistical inferences from monitoring results to the larger population, while providing practical flexibility. Notably, use of the spatially-balanced sampling algorithm facilitates plot locations to be dropped and replaced while still maintaining statistical validity of the sample. We replace plots that do not meet *a priori* criteria, including those not containing at least one tree of the target white pine species.

Plots are randomly assigned to one of three panels of equal sample size. Each panel is surveyed once per 3 years, and rested for two years in what is referred to as a "rotating panel design" (Urquhart and Kincaid 1999). This approach is effective when the primary objective is to determine temporal trends in measured variables, and enables larger total sample sizes to be achieved. We use a hierarchical (nested) model (Piepho and Ogutu 2002) for trend modeling that allows for analyses at park, network, and regional levels.

Monitoring plots are 50 m x 50 m and are marked on the corners by rebar. Analyses of pilot data indicated that this plot size was optimal with respect to reducing variation in measured outcomes. All trees (i.e., all species, alive and dead) that are taller than 1.37 m are tagged with numeric stainless steel tags. Nine 3 m x 3 m regeneration subplots are located within the larger plot. Species, height, diameter at 1.37 m (dbh), and live or dead status are recorded for each tagged tee. For white

pine trees, we record active blister rust (*Cronartium ribicola*) cankers, and whether there are three or more symptoms of rust infection (other than an active canker) located in the same third and area of the tree (for example, upper third of the bole). We also record presence of pine beetle (*Dendroctonus ponderosae*) infestation, dwarf mistletoe (*Arceuthobium cyanocarpum*) infection, percentage of crown kill, and presence or absence of ovulate cones for each white pine tree. Seedlings of all tree species within the nine regeneration plots are identified to species and placed in one of three height classes: 1) 20 to 50 cm; 2) 50 to 100 cm; and 3) 100 to 137 cm.

We record presence or absence of Clark's Nutcracker (*Nucifraga columbiana*) within 200 m by each survey hour for each plot location. Sight and sound of red squirrels (*Tamiasciurus hudsonicus*) in Craters of the Moon, and Douglas's squirrel (*T. douglasii*) in SIEN parks are also recorded by each one-hour interval. In addition we record whether plots contain an active squirrel midden (a cone storage site), and indication of cones eaten on site, but not located within 5 m of an active midden (referred to as 'fresh cones').

First year results

In 2011 we installed and sampled 32 plots in Craters of the Moon that contained a total of 415 limber pine trees. Of these trees, only 2 were dead, although 30 dead trees unidentified to species were also encountered. No limber pine trees were found with signs of blister rust infection in plots. However, there is active blister rust infection in a small stand of limber pine trees at the north end of the monument, discovered in 2006. No live limber pine showed signs of attack by pine beetles, but 26% of live limber pine trees in CRMO were infected with dwarf mistletoe. In general, limber pine stands in this arid lava landscape are rather sparsely populated. The average number of limber pine trees per 2500 m^2 plot (1/4 ha or 0.62 ac) was only 13. Seventy one % of live trees (*n*=413) had produced female cones. Clark's Nutcrackers and red squirrels were each detected in 10 of 32 plots.

A total of 11 plots were established in Yosemite's whitebark pine stands in 2011. 1039 whitebark pine trees were encountered in plots, including 1 dead whitebark pine. An additional 20 unidentified dead trees were also recorded. No signs of active blister rust infection were found in plots. However, in 2010, blister rust infection was identified on a whitebark pine tree in a U.S. Geological Survey long-term monitoring plot (established approximately 15 years ago) on Mount Gibbs in Yosemite. One live whitebark pine tree showed signs of mountain pine beetle infestation, and there was no sign of mistletoe infection in any plot. The average number of whitebark pine trees per plot in Yosemite was 94. Eighteen % of live whitebark pine trees produced female cones during the survey year. Douglas's squirrel sign was not noted in any of the 11 plots, but Clark's Nutcrackers were encountered in 7 plots.

Seven plots were established in the foxtail pine stands of Sequoia and Kings Canyon, which in one case also included whitebark pine. A total of 225 live foxtail pine trees were measured and tagged across the 7 plots, as well as 86 live whitebark pine trees in one dense plot. 31 dead trees unassigned to species were also recorded. As in the other parks, no signs of blister rust infection were found. There were no signs of mountain pine beetle or mistletoe infestation either. The average number of foxtail pine per plot was 32 Sixty % of foxtail pines had female cones from the survey year. Signs of nutcracker presence were recorded in 2 plots during the survey, but no squirrel sign was encountered.

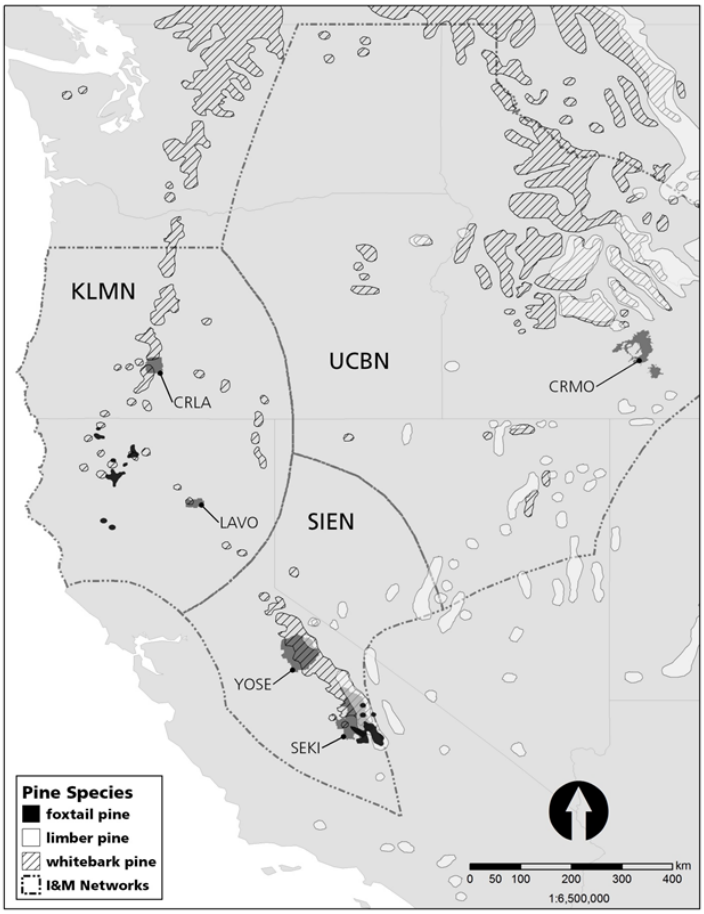

Figure 1

Distribution of whitebark pine, limber pine, and foxtail pine (from Little 1971), boundaries of the three Pacific West Region Networks, and National Park locations where the protocol is implemented. Network abbreviations: KLMN=Klamath, SIEN=Sierra Nevada, UCBN=Upper Columbia Basin. National Park unit abbreviations: CRLA=Crater Lake, LAVO=Lassen Volcanic, YOSE=Yosemite, SEKI=Sequoia and Kings Canyon, CRMO=Craters of the Moon.

Discussion

First-year results of this long-term monitoring effort demonstrate that the two key stressors, blister rust and mountain pine beetle, causing severe declines elsewhere, have not taken hold in these more southerly populations of the pines. It is refreshing to see that in the 1762 live white pines encountered, none exhibited sign of

rust infection, and only one indicated mountain pine beetle attack. However, this rosy outlook is dampened by the fact that both blister rust and mountain pine beetle are known to occur within these parks, and indeed affect the target white pine species. This fact makes consistent and prolonged monitoring all the more important. This project is designed to identify in a spatially and temporally explicit way, occurrence and intensification of the stressors, and increasing trends in tree mortality. This information will be particularly powerful if incorporated into an adaptive management framework, where it can be used to formulate sound, science-based management decisions at the park-level prior to severe population declines.

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Whitebark Direct Seeding Trials

John Schwandt and Clay DeMastus
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Many areas needing whitebark pine restoration are very remote, and planting seedlings may not be logistically or politically feasible, so it is critical to determine if direct planting of seeds will work, and what treatments will be needed to enhance germination and chances of survival.

Based on the results from early tests, six direct seeding trials were installed in northern Idaho and Montana to test and monitor a variety of seed treatments to enhance seed germination. Four trials were installed in 2009: Fairy Lake on the Gallatin National Forest near Bozeman, MT., Thompson Peak on the Lolo National Forest near Plains, MT., Ulm Peak on the Idaho-Montana state line west of Thompson Falls, MT., and Gold Pass on the Idaho-Montana state line west of St. Regis, MT. Two additional sites were installed in the fall of 2010: Toboggan Ridge above the Lochsa River on the Clearwater National Forest in Idaho, and Yellowstone Club ski area near Big Sky, MT.

Approximately 1000 seeds collected from local seed sources were planted at each site in a randomized complete block design with five replicates of eight treatments with 20 seeds per treatment. Treatments included: a 30-day warm stratification, scarification by sanding, a combination of warm stratification plus scarification, and control (no treatment). One half of the seeds were planted inside wire mesh cages to prevent rodent predation. Microsites were created at three sites using logs or snow fences to provide shade.

We also planted caches with three seeds each at the base of 2-year old seedlings at each site to monitor germination and survival of both seeds and seedlings over time. Temperature gages were installed at each site to record hourly soil surface temperatures. All sites are examined as early in the spring (summer) as possible and again in the late fall to document seed germination and seedling survival.

RESULTS

Germination

First year preliminary results for the four 2009 sites were reported at the High Five Symposium in the fall of 2009 (Schwandt, 2011), and showed that seed treated with warm stratification or scarification germinated strongly the first year after sowing (Fig. 1). During the second year, germination of the treated seed only increased 4% while germination of the untreated control seed increased from 13% to 33% (Fig 1.) After two seasons, the average germination of the warm stratified seed was 51%, while the average for seed treated with both warm stratification and scarification was 44%, and the average germination for the scarified seed was only 18%. Although germination at the four sites varied considerably, the overall pattern was similar for all sites. The Fairy Lake site was the harshest site which is probably why it had the lowest germination rates regardless of treatment (Table 1.) Germination of the seed outside the rodent cages was only slightly lower than germination inside the cages, so these treatments were combined in this report.

Of the two trials that were established in 2010, the Yellowstone Club site results were similar to the 2009 sites while the Clearwater site (Toboggan Ridge) had about 40% germination in all treatments including the control (Table 1).

Table 1. Percent germination by site and treatment after (1) or (2) years

Site	Warm Strat.	Warm Strat. + Scarify	Scarify	Control	Total Germ.
Fairy Lake (2)	24%	22%	9%	18%	18%
Ulm Peak (2)	52%	43%	12%	31%	34%
Gold Pass (2)	72%	51%	27%	42%	48%
Thompson Peak (2)	56%	59%	23%	39%	44%
2-yr Average Germination	***51%***	***44%***	***18%***	***33%***	***36%***
Toboggan Ridge (1)	42%	38%	42%	42%	41%
Yellowstone Club (1)	42%	30%	32%	17%	30%

The seed caches at the four sites established in 2009 with untreated (control) seed had very low germination the first year except for Thompson Peak (Table 2). However, germination increased dramatically at Ulm Peak and Gold Pass after the second winter. The

two sites established in 2010 with cached seed that had been warm stratified had nearly 30% germination the first year. The nearly 60% germination of cached seed at Thompson Peak the first year is very interesting since the non-cached control seed nearby only had about 30% germination the first year.

Table 2. Percent germination of cached seed by site and year

Site	1st Yr	2nd Yr	Total
Fairy Lake	3%	1%	4%
Ulm Peak	0%	22%	22%
Gold Pass	4%	30%	34%
Thompson Peak	59%	7%	66%
Toboggan *	26%	NA	26%
Yellowstone Club *	29%	NA	29%

* cached seed was warm stratified prior to planting

Table 3. Minimum and maximum soil surface temperatures by site

Site	Low Temperature	High Temperature
Fairy Lake	26.1°F	104.7 °F
Ulm Peak	22.8 °F	155.5 °F
Gold Pass	23.7 °F	151.0 °F
Thompson Peak	22.0 °F	140.9 °F
Toboggan Ridge	27.6 °F	136.4°F
Yellowstone Club	24.7°F	119.1 °F

Survival

Once the seeds germinate, it appears that survival rates are relatively similar regardless of the seed treatment (so far). After two years, survival of germinated seed averaged 65%. However the actual survival of all the planted seed varied dramatically depending on the treatment and location (Fig 2).

Temperature

Temperature gages documented surface temperatures ranging from 22 to over 150 degrees F (Table 3). Gages in the shade were consistently much lower than those in the sun, so finding shady planting locations may be critical to seedling survival. Once snow covered the sites, the soil surface temperature held constant at 32 degrees F until snow melt in the spring (usually from October until June or July).

FUTURE PLANS

The six currently installed sites will continue to be monitored for 3 years to document germination, and then a sample of any ungerminated seed will be dug up to determine seed viability. Survival of seedlings from germinated seed as well as planted seedlings both with and without a mycorrhizal treatment will be monitored for a longer period of time. In 2011 we installed temperature gages below the soil surface where seeds were planted (approximately 1.5 inches below the surface) to monitor

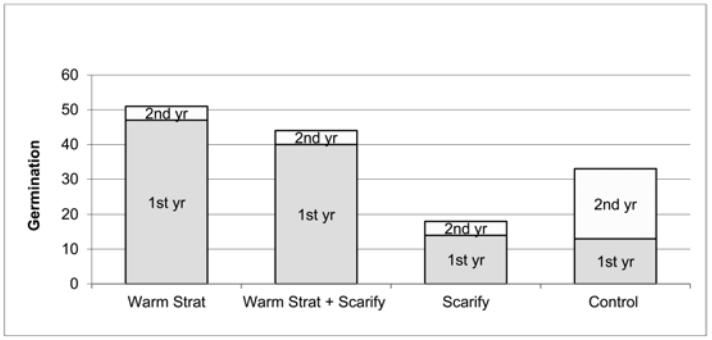

Figure 1. Average germination at four sites by year and treatment.

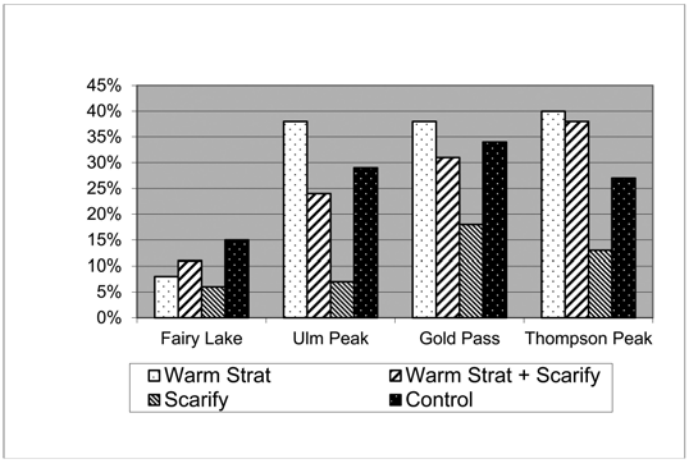

Figure 2. Percent survival of germinants after two years by area and treatment

temperatures in the immediate vicinity of the seeds. We will continue to monitor and compare these temperatures with surface temperatures and survival over the next several years to document effects of shade or seed treatments on seedling survival.

We would like to establish trials at additional sites to gain a better understanding of where direct seeding may be of the most value. Limited trials in Oregon and Washington are underway, but we would like to encourage additional trials throughout the range of whitebark pine.

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Genetic Resistance: A key to restoring highly impacted trees

R. A. Sniezko, USDA Forest Service, Dorena Genetic Resource Center

(adapted from an earlier IUFRO News Summary Report)

The Fourth International Workshop on the Genetics of Host-Parasite Interactions in Forestry – Disease and Insect Resistance in Forest Trees was held

July 31- August 5, 2011 in Eugene, Oregon. Native and non-native pathogens, insects and animals continue to negatively impact forest ecosystems, managed forests and urban plantings worldwide. Climate change will alter host/damage agent relationships and will likely increase detrimental impacts. Genetic resistance within tree species is a fundamental element to maintaining forest health. Utilizing genetic resistance is one of the few management options available to combat the impacts of insects, animals and pathogens and is the "green", sustainable avenue. Applied resistance programs, including resistance breeding, will be vital as they increase the efficiency in utilizing genetic variation to maintain or restore forest health when mortality or damage becomes unacceptably high.

It has been three decades since the last international workshop on 'Resistance Breeding in Forest Trees to Pathogens and Insects'. During this time, ongoing resistance programs have made significant progress, and several new serious insect and pathogen problems have arisen. Scientists from around the world with experience in genetics, tree breeding, pathology, entomology, physiology, evolutionary biology, forestry and other related areas came together during summer 2011 to help advance progress in genetic resistance programs by fostering collaboration between scientific and management communities.

The International Workshop in Eugene brought together 88 participants from 12 countries for 90 oral and poster presentations to exchange information. In addition, the fieldtrip allowed participants to see ongoing applied operational resistance programs to two pathogens: *Cronartium ribicola* (white pine blister rust) and *Phytophthora lateralis* (Port-Orford-cedar root disease).

Fog chamber for white pine blister rust inoculation at Dorena Genetic Resource Center (Photo: R.Sniezko)

The meeting included many forest tree species highly impacted by pathogens or insects and provided an opportunity to discuss knowledge and use of genetic resistance as a key tool for managers in helping maintain or restore healthy native and managed forests and urban plantings. Knowledge of this resistance allows managers to potentially become more proactive. Some of the subjects covered included cross resistance, durable resistance, tolerance, screening methodologies, molecular tools and field results. White pine blister rust resistance work in whitebark pine, western white pine, sugar pine, Rocky Mountain bristlecone pine, eastern white pine and limber pine was discussed at the workshop. Among other things the fieldtrip featured a visit to Dorena Genetic Resource Center to see these species and Southwestern white pine, and a visit to another site to see a dramatic example of resistance in a western white pine field trial.

An understanding of the genetic resistance of our native species is a basic need to permit efficient management and proactive activities. Several genetic resistance programs and the underlying research have made significant progress and results from field validation plantings show encouraging results. Most of the non-native pathogens and insects are likely to be permanent residents of our ecosystems and the more concerted effort we can make in understanding, developing and using genetic resistance would benefit our natural or planted forests.

A book of abstracts and presentations from the live webcast are available on the meeting web page (and associated links) at: http://ucanr.org/sites/tree_resistance_2011conference/. Publication of the presentations from the meeting is planned. ■

Mountain Pine Beetle Dynamics in Whitebark Pine

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Warming temperatures and dry conditions are major factors driving much of the current outbreak of mountain pine beetle in western North America. Warmer temperatures support greater beetle productivity and survival, and drought creates stress in trees lowering their defenses to the beetle. Climate change has also allowed an expansion of the mountain pine beetle's range into high elevation forests of whitebark pine. This expansion differs from those of the past. Historically, beetles moved upslope and developed outbreaks in whitebark pine only during abnormally warm, dry periods, but were then forced back downslope when cooler conditions returned. Unfortunately, with warming the beetle is predicted to become a permanent and major player in whitebark pine forests.

The current outbreak of mountain pine beetle in whitebark pine has been extensive and devastating. Many researchers have noted that the rate of tree mortality is more rapid in whitebark than in lodgepole pine and that the beetle exhibits a marked preference for whitebark pine. The reasons for mountain pine beetle's preference for whitebark pine and its rapid spread in this tree species are unknown. Possibilities include lower innate tree defenses, thicker or more nutritious phloem resources, or greater sensitivity and earlier development of stress to drought. Unfortunately, to date there have been no published studies that have definitively

determined what tree characteristics most influence the beetle's dynamics in whitebark pine.

While phloem has been found to be thicker in whitebark than co-occurring lodgepole at some sites, at other sites it has been found to be equal to or even thinner than in lodgepole pine (Baker et al. 1971, Six and Adams 2007, Six unpublished data). The degree of resin production also appears to be variable (Six unpublished data). At some sites, resin flow was significantly lower in whitebark pine indicating this tree may be easier to overwhelm than lodgepole pine. However, at other sites no significant difference in resin production between the two tree species was detected. Interestingly, at sites where resin flow was similar, neither tree produced much, if any, resin. There has also been an overall tendency for resin flow to decrease in both species over time in subalpine sites (from 2002 to 2008).

It is likely that the extended drought in the West has affected the resin defenses of both trees. However, it appears that whitebark pine is either innately less defensive than lodgepole pine and/or becomes stressed earlier than lodgepole pine due to drought. This may explain, at least in part, why for many years the beetle exhibited a strong preference for whitebark pine and expanded rapidly in whitebark pine forests while adjacent or interspersed lodepole pine remained relatively untouched. In the last three years, we have seen increasing levels of mortality in lodgepole pine along with whitebark pine in high elevations sites. This may reflect low resin production by both species as the drought becomes more prolonged.

Record-setting cold temperatures in October, 2009, as well as cooler, wetter weather due to La Nina, may have provided bit of a reprieve from the beetle for whitebark pine. The cold snap resulted in the collapse of beetle populations at some sites. In addition, cooler temperatures and higher precipitation in 2010-2011 have likely relieved water stress and allowed trees to develop better defenses. This may greatly delay a rebound by the beetle at sites where beetle populations crashed and potentially slow beetle activity at other sites.

We do not know how long this reprieve will last. It is likely that the return of dry, warm conditions when La Nina is replaced with El Nino will once again support rapid increases of the beetle. However, before that happens, the cold snap/La Nina events may be a way for us to 'step back in time' a bit to when conditions were not so conducive to beetles and to begin studies to assess how whitebark and lodgepole pine respond to changing environmental conditions. By starting now we may be able to better identify what tree physiological responses are associated with increasing beetle populations as well as their preference for one tree species over another. By tracking changes in tree physiology and defenses that occur as conditions change from cooler and wetter to drier and warmer and which changes are associated with increased beetle activity we can gain knowledge useful in predicting the extent of beetle activity in the future, prioritizing efforts at maintaining this tree on the landscape, and locating areas most appropriate for conservation or restoration.

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Bark Beetle Productivity in Whitebark and Lodgepole Pine

Edie Dooley, College of Forestry and Conservation
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Current outbreaks of mountain pine beetle (MPB, *Dendroctonus ponderosae*) in whitebark pine (*Pinus albicaulis*) have been ongoing since the early 2000s. MPB outbreaks typically occur in its co-evolved host, lodgepole pine (*Pinus contorta*), which generally grows at lower elevations than whitebark pine although the two trees can grow in mixed stands. Compared with MPB outbreaks in whitebark pine in the 1930's and 1980's (Perkins and Swetnam 1996), the geographic extent of the current outbreak is considered unprecedented (Logan et al. 2010). In 2009, in the Greater Yellowstone Ecosystem, where this study took place, approximately 82% of the whitebark pine was moderately to highly affected by MPB (MacFarlane et al. 2010). The current outbreak is most likely driven by warming temperature in the high elevations facilitating one year MPB life cycles (univoltine) in places where two-year life cycles (semivoltine) were common in past decades (Logan et al. 2010, Logan et al 2003). A semivoltine life cycle is unfavorable for MPB because it challenges beetles to survive two winters in the inner bark of a dying tree where moisture and nutritional content are continually declining. Now that MPB are univoltine in whitebark pine, they are more likely to emerge and attack en masse–a scenario which makes outbreaks of epidemic proportions possible.

While climatic warming is apparently playing a role in the current MPB outbreaks in whitebark pine, it does not necessarily explain the alarming scope of the outbreak. It is possible that physical or physiological differences between whitebark and lodgepole pine cause whitebark pine to be a more favorable host than

lodgepole pine. A superior host is expected to allow production of more and/or larger beetles. Size of female MPB, and number of eggs laid have been found to be positively correlated (McGhehey 1971). More beetles – either mediated through number of eggs, or increased survival of eggs-- translates to more attacking beetles, and therefore, more MPB-killed trees. Researchers have long noted that whitebark may be a more preferred host for MPB than lodgepole pine (Evenden 1944, Baker et al. 1971, Waring and Six 2005). It also appears that the speed and degree of MPB-caused stand mortality in whitebark is amplified compared with lodgepole pine. This apparent difference could be driven by weaker host defenses in whitebark, which is suspected from the scarcity of defensive pitch tubes (Logan et al. 2010). Alternatively, whitebark pine could provide better nutrition, or superior protection from environmental elements –both of which would result in a larger beetle population.

To determine if whitebark pine is superior to lodgepole pine as a host for MPB, I undertook a study comparing the rates of MPB attack density and emergence, as well as beetle size between whitebark and lodgepole pine. To ensure that environmental conditions were the same for both tree species, I located three mixed stands of whitebark and lodgepole pine that were currently infested with MPB. One site, Vipond Park was located west of Divide, MT, in the Beaverhead-Deerlodge National Forest. The other two sites were located in the Greater Yellowstone Ecosystem near Gardiner, MT, in the Gallatin National Forest (Palmer Creek), and at the southern end of the Wind River Range in the Shoshone National Forest, WY (Fiddler's Lake). Before brood MPB emergence, I counted and marked the number of parent attack holes in a 40 by 60cm rectangle marked on the north and south sides of 30 whitebark and 30 lodgepole pine at each site.

One attack hole represents a single parent gallery constructed by a male and female pair. In late summer and early fall, once brood beetles had emerged, I returned to the sites, relocated the trees and counted the number of brood emergence holes in the same sampling area. When brood MPB are not crowded in the trees, the pupal chambers in which the beetles develop do not converge, and brood beetles emerge out of individual holes (Safranyik and Linton 1985). Therefore, I assumed that a single emergence hole represents a single beetle. At the Vipond Park site, I stapled screen emergence cages (Figure 1) over the 40 x 60 cm caging area to collect any brood beetles that flew out of the caging area. I collected beetles approximately every two weeks between 4 August, 2010 and 11 October, 2010. I photographed each MPB from above using a dissecting microscope. The width of each beetle (a standard single measure of size) was measured from the size-calibrated photographs using Image J software. Generalized linear mixed model analysis was used to determine differences between tree species and effects of DBH on the variables measured (Zurr et al. 2009). Emergence rate was modeled as ratio of emergence holes per attack holes.

There was no difference in size of beetles between the two tree species. I found no significant difference in attack density between whitebark and lodgepole pine. However, there was a definite trend of whitebarks receiving on average 12% more attacks than lodgepole pine. Larger diameter trees of both species received more attacks; each one cm increase in diameter related to 3% more MPB attacks. Tree species was a significant predictor of MPB emergence rate. However the interpretation of this significance is complicated by the fact that the interaction of tree species and tree diameter was also significant; the difference in MPB emergence rate between whitebark and lodgepole pine is dependent on the diameter of the tree.

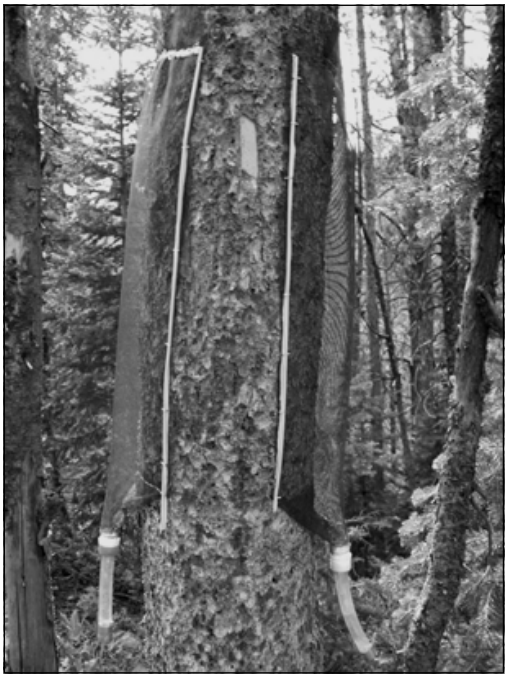
The correlation between MPB emergence rate and DBH in lodgepole is significantly positive, and is a long established relationship (Cole and Amman 1969). However, in whitebark pine where this relationship has not been studied, there is no relationship between tree DBH and MPB emergence rate. Therefore, in small diameter trees, whitebark produced more beetles on average than lodgepole pine, but in larger diameter trees, lodgepole produced more beetles on average than whitebark pine. At all three sites, populations of emerging beetles compared to attacking beetles declined by 94%, 12%, and 77% at Vipond Park, Palmer Creek and Fiddler's Lake respectively. This population decline was most likely caused by a late flight in 2009 which delayed MPB development and allowed them to be caught in a larval stage that was susceptible to cold mortality during a cold snap in early October 2009.

While there was no difference in beetle size or emergence rate between whitebark and lodgepole pine, there was a trend toward higher attack density on whitebark pine. Higher density of MPB attacks does not indicate that beetles prefer whitebark pine. Preference refers to which trees beetles initially choose to attack, not attack density (Baker et al. 1971, Waring and Six 2005). Instead, the higher attack rate on whitebark pine may be caused by its unique monoterpene blend, which synergizes MPB attractant pheromones better than lodgepole's monoterpene blend (Borden et al. 2008). Better synergism between host monoterpenes and beetle pheromones means that the beetle aggregation signal is amplified, thereby drawing in more beetles to those trees.

The joint findings that there was no difference in MPB body size, and the lack of a clear relationship between host species and emergence rate means that there is no difference in MPB output between whitebark and lodgepole pine, and thus whitebark pine is not a superior host for MPB. Therefore, the rampant rash of

MPB-caused whitebark pine mortality across the landscape appears to be driven by a warming climate opening up more suitable habitat for beetles and not any inherent beetle developmental advantage conferred whitebark pine.

Figure 1. Photograph of screen cages used to collect beetles emerging out of the north and south aspects of trees.



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Whitebark Pine Featured in Manning Park

Judy Millar, Terrestrial Ecologist
British Columbia Parks

British Columbia Parks is celebrating 100 years since the designation of its first park in 1911. The agency manages 999 protected areas--including parks, protected areas, ecological areas and conservancies-- comprising 13 million ha and around 14% or the province.

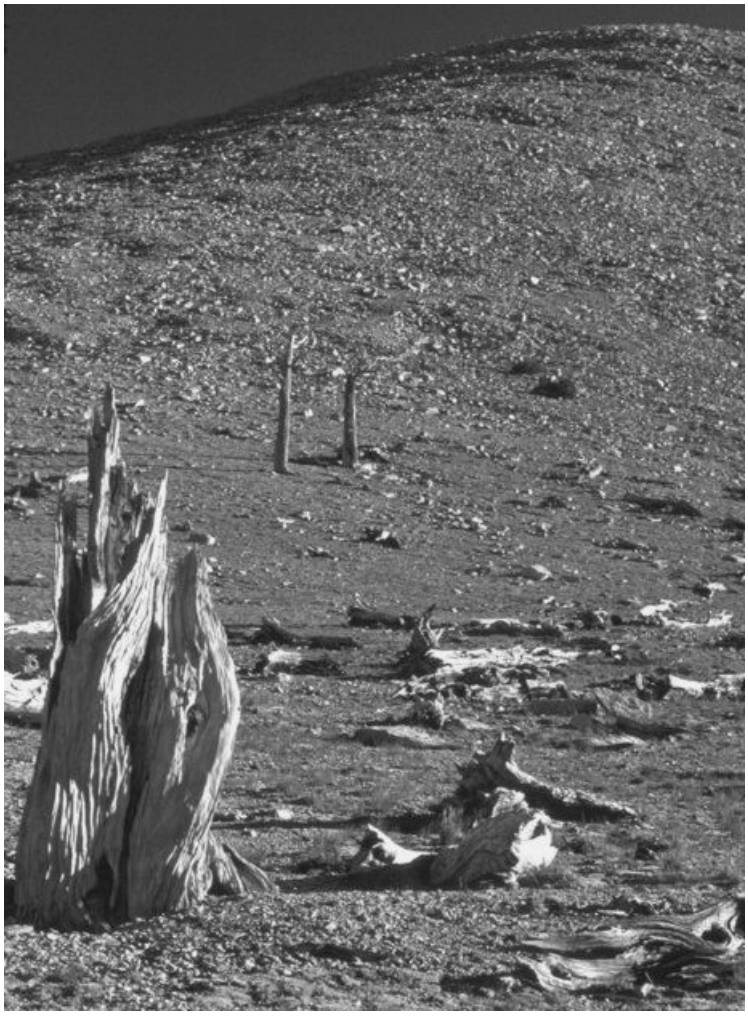
E.C. Manning Park is well known for its outdoor recreation and is unique in British Columbia. The park is located in the heart of the Cascade Mountains and is within a three hour drive from either the the Vancouver metropolitan area to the west and Okanagan Valley communities to the east. The park contains a large number of scenic, historic, floral and fauna attractions and provides a wide range of both summer and winter recreational opportunities.

Manning Park also is noted for its accessible display of whitebark pine and Clark's nutcrackers. On September 23, 2011, a BC Parks "100 Celebration" was held in honour of the efforts by Randy Moody, Don Pigott and Judy Millar as 100 whitebark pine trees were planted by volunteers. The seeds were collected in 2007 from this location, the trees grown in a nursery and then returned to the park (4 years later).

The volunteers were organized by local BC Parks staff Ed Atkinson and Kirk Safford. There were 35 volunteers from naturalist and outdoor clubs and 35 students and teachers from a nearby high school who came to listen to Randy Moody's presentation on whitebark pine ecology. Following the presentation the volunteers helped to plant the trees in beautiful sunshine and crystal clear air.

The volunteer/school group organizer was Kelley Cook, a local park enthusiast from Hope, BC. Lunch was provided by BC Parks. The students enjoyed themselves and learned about the dynamic relationship of the 5-needled pine and wildlife. The outreach component was a huge success. The trees were planted and the park is happy.

Three volunteers planting trees at Blackwall Peak, Manning Park.



Foxtail pine ghost forest, Sequoia-Kings Canyon NP, Photo by Tony Caprio

Beartooth field trip. Photo by Michael Mancuso

Michael Murray using tree tongs on Beartooth field trip. Photo by Michael Mancuso.

Whitebark Pine Ecosystem Foundation Board of Directors at Cody, WY