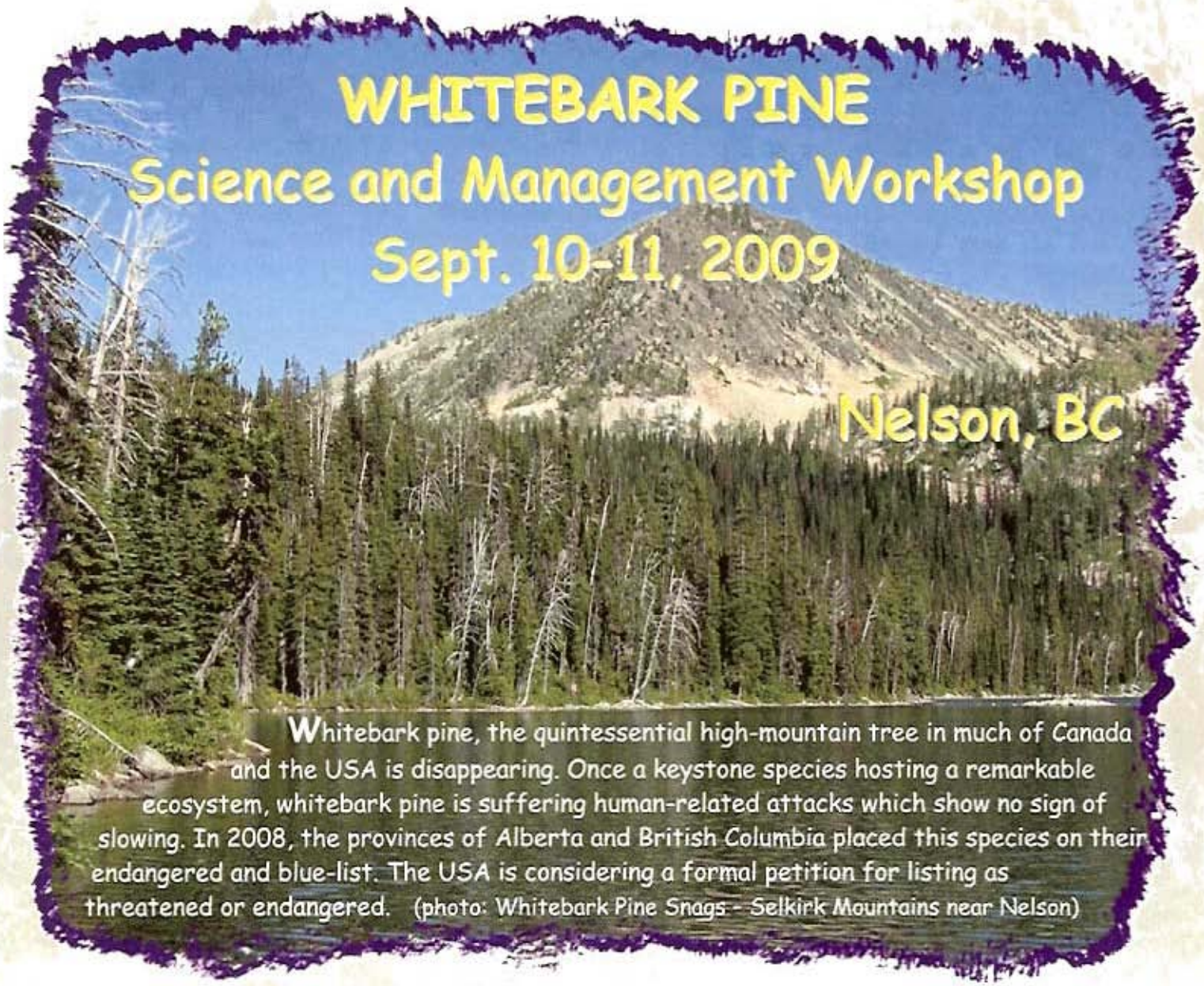
Issue No. 16: Spring/Summer 2009

Nutcracker Notes

Whitebark Pine Ecosystem Foundation



Whitebark pine, the quintessential high-mountain tree in much of Canada and the USA is disappearing. Once a keystone species hosting a remarkable ecosystem, whitebark pine is suffering human-related attacks which show no sign of slowing. In 2008, the provinces of Alberta and British Columbia placed this species on their endangered and blue-list. The USA is considering a formal petition for listing as threatened or endangered. (photo: Whitebark Pine Snags - Selkirk Mountains near Nelson)

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Whitebark Pine Ecosystem Foundation
***Nutcracker Notes*, Issue No. 16; Spring/Summer 2009**

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WPEF Election Ballot (*Separate Form Enclosed*)

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>

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Director's Message

Diana F. Tomback

Petition to list whitebark pine as a T&E species

As many of our (WPEF) members no doubt know, the Natural Resources Defense Council submitted a petition to list whitebark pine as an endangered species to the U.S. Fish and Wildlife Service in December, 2008. The initial 90 day evaluation of this petition was delayed by transition to a new administration and delayed approval of the FY2009 budget. This first level review is about to begin, and is described in a separate article is this issue of *Nutcracker Notes*. Whether whitebark pine goes to the next level of review will depend on "substantial information" indicating a threat to the species across its range.

Since the early 1990s, and particularly over the last 10 years, a number of published and unpublished regional surveys have examined the health of whitebark pine throughout its U.S. and Canadian distribution, providing a reasonably complete picture of the status of this species, particularly as impacted by white pine blister rust, caused by the invasive fungal pathogen *Cronartium ribicola*. Furthermore, information from aerial detection surveys on the mortality of high elevation white pines caused by the recent outbreaks of mountain pine beetles was recently synthesized in Gibson et al. (2008, USDA Forest Service, Forest Health Protection R1-08-020, available on the internet). The data indicate that the geographical extent of whitebark pine mortality between 1998 and 2007 is much greater than that for any other high elevation white pine. In 2007, mountain pine beetles killed whitebark pine across nearly a half million acres throughout seven western states, including over 200,000 acres in Wyoming alone. Ground surveys indicated up to 96% of whitebark pine were killed within a plot, including trees as small as 5 inches in diameter in the greater Yellowstone Area.

The precarious status of whitebark pine is now recognized in Alberta (see the article by Peter Achuff). In 2008, the Minister of Alberta Sustainable Resource Development approved Endangered Species status for both whitebark and limber pine under Alberta's Wildlife Act. Furthermore, whitebark pine in Canada is now ranked by NatureServe as "vulnerable". A report on the rangewide conservation status of whitebark pine in Canada was recently submitted to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) for review under the Canada Species at Risk Act. But, there are many regions in the northern Rocky Mountains and Northwestern U.S. where whitebark pine is in worse shape than it is in Canada.

Managers and researchers in the U.S. Forest Service and National Park Service have been sounding the alarm about the health trajectory of whitebark pine for more than 20 years. We formed the Whitebark Pine Ecosystem Foundation in 2001 to raise awareness of the situation and to encourage whitebark pine restoration. Regardless of whether whitebark pine is granted T & E status, major funding must be made available for its restoration. This investment should include the development of an effective rangewide restoration strategy, based on integrating current information in genetics, pathology, and ecology. This strategy should prioritize areas within regions, and make efficient use of resources. Furthermore, we need new management approaches to enable whitebark pine to respond to the effects of climate change and, if possible, to minimize the potential for severe damage by mountain pine beetle outbreaks.

FHP Whitebark pine restoration fund

This past year, the Whitebark Pine Ecosystem Foundation, in partnership with the Arbor Day Foundation (ADF), offered $30,000 to supplement the USFS Forest Health Protection Whitebark Pine Restoration Fund. Our mutual contribution will primarily go to support planting projects approved by the Forest Health Protection (FHP) Technical Committee, in keeping with the role and mission of ADF. This summer we expect a good whitebark pine cone crop, and cone collecting proposals, appropriately, were well represented among those to be supported by the FHP Fund. The WPEF would like to rebuild its own Whitebark Pine Restoration Fund. When it is time to renew annual WPEF memberships, we hope that members will help by making a donation beyond the basic membership fee to our restoration fund.

September 2009 Annual Meeting

Join us in the beautiful resort town of Nelson, British Columbia, this fall, September 10-11, 2009, for WPEF's annual meeting. This mini-

conference and field trip is hosted by WPEF board member Dr. Michael Murray, who works for the British Columbia Forest Service. The Science and Management Workshop will emphasize the status of Canadian whitebark and limber pine, and provide an opportunity to strengthen our trans-boundary interests. The location also provides access to outstanding whitebark pine habitat in the nearby Selkirk Mountains

"High Five" Symposium and annual members' meeting

Just a few weeks ago, we sent out a date-saver flyer, which is also available on our website www.whitebarkfound.org, announcing a major meeting for managers, researchers, and graduate students, *"High-Five" Symposium: The future of high-elevation white pines in western North America*. In the decade since our 1998 whitebark pine symposium, much has transpired in white pine ecology and status: Not only is whitebark pine declining rapidly, but other high elevation white pines are under serious threat, compounded by an unprecedented mountain pine beetle upsurge and a warming climate. Much new ecological and genetic information is available, as well as information on distribution, health status, and restoration strategies. The chief of logistics for the meeting is board member Carl Fiedler, and the program chair is board member Bob Keane. Please see the accompanying article in this magazine for details.

Transitions and elections

Steve Shelly, who has been Treasurer of the WPEF nearly since its inception, stepped down this spring. We are truly grateful to Steve for his dedicated service to the WPEF over the years, and for developing most of our financial protocols and practices. Steve transferred his duties to new Treasurer Ward McCaughey this spring. Ward is a past board member who retired recently from the Rocky Mountain Research Station (USFS). Welcome back, Ward! I hope all members will participate in WPEF's 2009 election; please cast your vote using the enclosed ballot. We are pleased to have five well-qualified candidates running for the three available board seats The WPEF depends on the dedication of its board members to provide direction in these challenging times. Bryan Donner, Membership and Outreach Coordinator, was re-elected by acclamation. Bryan, thanks for your continuing service! ■

WPEF's Conference & Field Trip: Nelson, B.C., September 10-11, 2009

The vibrant town of Nelson, BC, three and a half hours drive north of Spokane, is hosting WPEF's annual conclave. With a population of about 10,000, Nelson is the cultural and administrative center for the Kootenay district. Nelson has been called "the number one Small Arts Community in Canada." Baker Street is the heart of Nelson, where a vibrant procession of street musicians, shoppers, tourists, and locals mingle among some of the most attractive turn-of-century architecture in Canada. In fact, Nelson has more "Heritage Buildings" (350) per capita than any other city in BC. Recreation, education, mining, timber, and tourism are pillars of the economy. Situated on an arm of Kootenay Lake, Nelson is surrounded by the spectacular Selkirk Mountains which support whitebark pine, grizzly bears, mountain caribou, and alpine glaciers.

This year's speaker program will feature Canadian aspects of whitebark pine science and management, but will include science and management updates from the U.S. too. Brendan Wilson will illustrate and describe local whitebark pine communities. Cyndi Smith will summarize remeasurements of whitebark and limber pine status throughout the Canadian Rockies including findings and implications. John King and David Noshad will discuss blister rust screening. Pat Field will highlight the new Nature Conservancy area (136,000 acres) known at the "Darkwoods" containing whitebark pine near the junction of BC, Idaho, and Washington. Other presentations will include monitoring, the mountain pine beetle epidemic, climate change, and updates on legal ("listing") status of whitebark and limber pine in Canada and the U.S. A field trip guided by local whitebark pine experts will allow participants to experience and learn about the Kootenay country's high-country ecosystem.

See inside back cover for map and travel information. ■

Announcing the "High-Five" Symposium

Focusing on the Future of High-Elevation Five-Needle Pines in Western North America (June 28-30, 2010)

The Whitebark Pine Ecosystem Foundation is in the midst of planning a 2010 symposium on high-elevation white pines in western North America. This "High-Five" Symposium will address the future of whitebark, limber, foxtail, Southwestern white, and Rocky Mountain and Great Basin bristlecone pines. Given the potentially disastrous threats facing five-needle pines, this event will be a crucial coming together of concerned scientists, managers, educators, and citizens to focus on what can be done to restore and sustain these ecosystems. The conference will include two days of plenary and contributed oral presentations and an optional field trip on the third day. Canadian scientists and managers will participate as cross-border partners to showcase the latest information on the ecology, status, threats, restoration, and management of five-needle pines throughout their distribution.

A call for papers across a broad range of topics will be announced this summer. The conference is scheduled for June 28–30, 2010, on the University of Montana campus in Missoula. It will include an ice-breaker and poster session, a low-cost (dormitory) accommodation option, a limited number of "scholarships" to offset travel or registration costs, and proximity to UM's interesting bookstore, espresso shops, and snack and lunch options. The Foundation is actively seeking financial co-sponsorship of this event to provide money for "scholarships" and to offset facility rental fees and other expenses associated with staging a high-quality symposium. ■

2009 Whitebark Pine Restoration Program

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

Once again the Whitebark Program (coordinated by USFS, Forest Health Protection) (FHP) requested proposals for restoration projects and we were overwhelmed by responses. We received 52 proposals from across the West requesting nearly $1 million.

Although our initial funding level ($150,000) was 25% less than the 2 previous years, additional funding from other FHP programs plus the Whitebark Pine Ecosystem Foundation (WPEF) provided enough funds to compensate for this reduction.

The high quality of proposals made the selection process very challenging, but the Whitebark Pine Technical Committee finally recommended full or partial funding for 19 projects. However, thanks to the additional funding, we were able to increase this total to nearly 30 projects and fully fund the original 19 (see Table).Total FHP funding is expected to be above $300,000 and we are still hoping to add a few additional projects. Please note that we are still waiting for final approval for some of these funds so funding for the projects listed below must be considered as pending.

The WPEF funds ($30,000) will be used for 3 planting projects;
Planting of 17,000 seedlings over 88 acres on the Clearwater Forest (Idaho Panhandle NF),
Blacktail Mountain Ski Area Planting project (Flathead NF) and
Partially fund the sowing and growing of over 4,000 seedlings for out-planting on the St. Joe NF.

Since 2009 is expected to be an excellent year for whitebark pine cone production, much of this year's program went towards 11 cone collection projects. However, with the additional funds, we also expect to help fund a total of 5 planting projects, 4 treatments to control competing vegetation, 5 survey/monitoring projects, and 2 special projects (see Table).

One of the most gratifying aspects to this program is the level of matching funds that are applied towards these projects. Matching funds for this year's program were over $325,000 which demonstrates the wide support that this program continues to receive from a very diverse group of partners.

article's table appears on page 6

WHITEBARK PINE RESTORATION PROJECTS - 2009

Title	Location – Agency/NF/RD
Survey/Monitoring	
Remeasure Permanent WBKP plots	GYA
Regen Assmt Watershed Property, Baker Lakes	Beaverhead-Deerlodge, Helena RD
Darroch-Eagle Timber Sale monitoring	Gallatin NF, Gardiner RD
Incidence of blister rust and bark beetle impacts	GYA
Post disturbance monitoring for WBK health	SNRA – Central Idaho
Cone Collections	
Operational collection for Grand Teton Seed Zone	GYA
Operational cone collection – 04-07 fires	Mission/Glacier Seed Zone- Flathead NF
Operational cone collection -2 seed zones	Clearwater NF
Operational cone collection - Simmons Peak	St Joe NF, Avery RD
Plus tree and Operational cone collections	R5 -Oregon and Washington
Cloudcap Whitebark pine cone collection	R6 -Mount Hood NF
Plus tree and Operational cone collections	R6-Mt Ranier & N Cascades N Pks
Plus tree Cone Collection Mission/Glacier Zone	Glacier National Park
Plus tree collections - Central Idaho	Salmon-Challis NF
Plus tree collections - Grand Teton Seed Zone	GYA
Plus tree collections & rust screening program	Boise, Toiyabe,Payette, Salmon-Challis NF
Planting	
Planting WBkP seedlings	Clearwater NF, Toboggan Ridge
Plant Blacktail Mountain Ski area	Flathead NF
Broadax sowing of 4,000 seedlings for planting	St Joe NF, Avery RD
Sow and Grow seedlings for fire restoration	Lolo NF
Fairy Lake planting project	Gallatin NF
Restoration treatments	
Alice Creek competition reduction	Helena NF, Lincoln RD
Snowbowl restoration, thinning, burning, release	Lolo NF, Missoula RD
Thinning to reduce competing vegetation	Kootenai NF, Fortine RD
Greenwood/Tepee WBP release	Lolo NF, Thompson Falls RD
Special Projects	
Factors influencing recruitment of WBKP	GYA
Inoculation of WBK with mycorrhizae fungi	Montana State University
Direct Seeding trials	Gallatin NF, IPNF, GYA

List Whitebark Pine under the ESA? Decision Process and Implications

Diana F. Tomback, WPEF Director

On December 8, 2008, the Natural Resources Defense Council (NRDC) submitted a petition to the U.S. Fish and Wildlife Service (USFWS) to list whitebark pine as an endangered species. An earlier draft of the petition had been independently reviewed by Jesse Logan, recently retired from the USDA Forest Service, Rocky Mountain Research Station, and myself in the capacity of Director of the WPEF. The final draft petition is posted on the NRDC website (http://docs.nrdc.org/legislation/files/leg_08120801a.pdf).

The position of the Board of Directors of the Whitebark Pine Ecosystem Foundation concerning the petition is as follows: Whether or not whitebark pine is listed as a threatened or endangered species, we recognize that populations throughout most of its range require management attention and, in many regions, the rapid implementation of restoration projects to maintain the species on the landscape over time. Whitebark pine is seriously threatened by the invasive pathogen *Cronartium ribicola*, which causes the disease white pine blister rust, and by widespread outbreaks of mountain pine beetles (*Dendroctonus ponderosae*); it is also threatened by fire suppression and climate change. Whether or not whitebark pine is listed as threatened or endangered will depend on the perception of threat by the U.S. Fish and Wildlife Service based on an assessment that considers the status of whitebark pine rangewide.

Here, I briefly describe the decision process and current status of the petition and also discuss management implications as I understand them. This information is the result of my discussions with Andrew Wetzler, Endangered Species Specialist, NRDC; Ann Carlson, Listing coordinator, USFW, Denver; Kristi Swisher, Endangered Species Coordinator, USDA Forest Service, Region 1, Missoula; Steve Shelly, Regional Botanist , USDA Forest Service, Region 1, Missoula; Mary Manning, Regional Vegetation Specialist, USDA Forest Service, Region 1, Missoula; Beth Dickerson, Wildlife Biologist, USFW, Helena; Brian Kelly, Wyoming Field Supervisor, USFWS, Cheyenne.

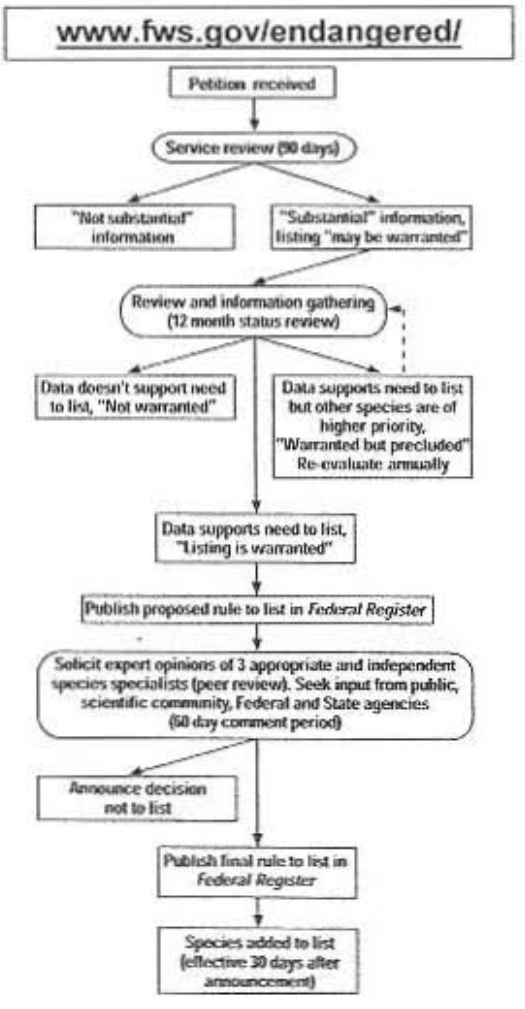
Listing process

The stated purpose of the Endangered Species Act (ESA) of 1973 is to protect *endangered* species, defined as those species at risk of extinction. Protection is also offered to *threatened* species—species that may become endangered in the near future. Section 4 of the Endangered Species Act describes the process of proposing a species for addition to the Endangered Species list; the process is summarized below in a flowchart reproduced from www.fws.gov/endangered/. In sum, upon receiving a petition, the USFWS is expected to make a decision within 90 days concerning whether or not there is "substantial information" suggesting that the species may be in trouble. If the initial review indicates there is cause for concern, then a full status review is conducted. The status review is required to be completed within 12 months of USFWS receiving the proposal. There are three potential outcomes to the full status review: listing is not warranted, the species is listed as threatened or endangered, or listing is "warranted but precluded." In the latter case, species receives a "candidate" species designation, and its status is revisited annually; full listing is deferred generally because of workload or funding limitations. Ultimately, when candidate species are finally evaluated, they are either listed

or a "not warranted" decision is still a possible outcome. When listing does finally occur, the species and its habitat become protected. Listing also entails the development of a recovery plan, which provides a course of action for both protecting and potentially improving the status of the species.

The Petition Process

For requests to list a species as threatened or endangered under the Endangered Species Act



The timing of the submission of the whitebark pine petition was problematic: the federal government was in transition to a new administration and the 2009 federal budget had not been passed. At first, initial review of the petition was postponed to 2010, but the Denver regional office began searching for funds to speed up this process. By statute, the 90-day process is expected to start upon receipt of the proposal, but if fiscal constraints exist, the process starts when funding is available. As of January, 2009, the petition was in the hands of the USFWS Helena office. Because of workload concerns, the Denver regional office moved the petition to the USFW Cheyenne, Wyoming office, under the supervision of Brian Kelly. Both Beth Dickerson and Brian Kelly have been very responsive to questions and outreach, actively soliciting input. Funds were received for the 90-day review, and this process will officially begin shortly. Even if the results of the 90-day review indicate that "substantial information" supports listing, the full status review may be delayed by a lack of funding; or, if whitebark pine is listed, the development of a recovery plan, which must be crafted carefully to include all restoration strategies and tools, could also be delayed for lack of funding.

Implications of listing

Many researchers and managers have expressed concerns about the implications of federal threatened or endangered status for whitebark pine. The prospect of listing has raised questions about whether current restoration practices will be permitted, such as prescribed fire which may lead to whitebark pine losses. Other questions include whether restoration activities may continue uninterrupted, even though a recovery plan is not in place, and whether seed collection will be possible. The overarching concern appears to be the possible impact of extra layer of "red tape" and bureaucracy.

If whitebark pine is listed, there is a mandatory USFW review of management actions that could impact whitebark pine. However, management plans are generally developed with USFWS to cover large administrative units, and project review can be expedited under these plans, which was confirmed by both USFS and USFW representatives. Furthermore, if whitebark pine is listed as a threatened or endangered species, and no recovery plan is in place, this will not stop restoration and recovery activities, according to Brian Kelly. However, these proposed activities will undergo a "Section 7" review with programmatic consultants to ensure that they are not further endangering the species. Brian confirmed that having restoration plans in place for large, administrative units would be regarded favorably, and would, in fact, expedite drafting a recovery plan. Beth Dickerson mentioned that the ESA has different standards for managing plants as opposed to animals. In the case of plants, some loss of individuals is permitted if there is overall benefit to the species.

Several Forest Service and USFW managers independently pointed out the benefits to listing whitebark pine. Most importantly, listing will attract attention and funding to whitebark pine. Secondly, listing is the impetus to development of cohesive recovery strategies across the range of whitebark pine. Finally, listing provides a mandate for action across regions, and motivates units that might otherwise not comply.

Action items

While waiting for decisions on the 90-day and then possibly the 12-month status review, agencies can be engaged in proactive and productive activities. First of all, regional management plans should be developed for whitebark pine, and targeted areas and restoration activities prioritized based on their long-term effectiveness and implementation efficiency. Individual National Forest plans should include specific strategies for restoring whitebark pine, responding to local conditions. If whitebark pine is listed, drafting of the recovery plan and regional MOAs with USFW will be expedited with these plans in place. If whitebark pine is not listed, we will have these plans to guide our collective restoration efforts. Those of us who study and manage whitebark pine know that it is unlikely to persist in many areas without our intervention. ■

Status of Whitebark & Limber Pine in Canada

Peter Achuff, Waterton Lakes National Park, AB, Canada
<peter.achuff@pc.gc.ca>

***Editor's Note**: Peter Achuff, Scientist Emeritus and former Chief Botanist for Parks Canada, reports the "listing" status of whitebark and limber pines as of April, 2009.*

Whitebark Pine

In October 2007, the **British Columbia** Conservation Data Centre ranked whitebark pine as *special concern/vulnerable* (S3?) and added it to its Blue List. The reasons were that, although the species currently occurs in high numbers over a large range in the province, "it is highly threatened by mountain pine beetle and white pine blister rust epidemics, climatic warming trends, and successional replacement." A major decline of 75-90% is expected in both population size and condition.

The Blue List includes species that are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. While blue listing provides no legal protection, BC government agencies have suggested voluntary conservation measures for consideration in planning and operational forestry activities. Whitebark pine has been logged in some areas, although the extent is unclear.
The "Conservation Status Report for *Pinus albicaulis*" is on-line at http://a100.gov.bc.ca/pub/eswp. Search for whitebark pine by its scientific or English name, then "reports" where you can find various other references as well.

In **Alberta**, whitebark pine is currently ranked as *imperiled* (S2). In October 2008, following the recommendation of the Alberta Endangered Species Conservation Committee, the Minister of Alberta Sustainable Resource Development approved the listing of whitebark pine as *Endangered* under the *Alberta Wildlife Act*. However, no regulations currently exist to permit listing of plants under the act and, thus, whitebark pine has no legal protection. New legislation is expected in 2010 to permit listing of plants.
Most whitebark pine in Alberta occurs either in protected areas (federal or provincial) or other provincial crown (public) land. In the latter, it is not a commercially harvested species and Alberta Sustainable Resource Development has taken measures to ensure both that whitebark pine is not inadvertantly harvested and that planning for forest management (harvesting, fire, mountain pine beetle) takes whitebark pine into account. Recent land use guidelines in southwestern Alberta include specific conservation measures for both whitebark pine and Clark's Nutcracker.
A provincial species recovery team (joint whitebark and limber pine) was formed in December 2008 and a recovery plan is expected by late 2009. The provincial status report is at http://srd.alberta.ca/fishwildlife/status/plantsinvertebrates.aspx

Whitebark pine's **National Status in Canada** is ranked by NatureServe (2007) as *apparently secure* (N4). However, that rank appears outdated given the recent provincial assessments above.

An unsolicited status report on whitebark pine, authored by Peter Achuff and Brendan Wil-

son, was submitted in January 2009 to COSEWIC (Committee on the Status of Endangered Wildlife in Canada) for assessment under the *Canada Species at Risk Act*. The report has been accepted for assessment, which is anticipated to be in spring 2010. Information in the report suggests that the species should be assessed as Endangered in Canada due to population decline.

Limber Pine

In **British Columbia,** limber pine is currently ranked as *special concern/vulnerable* (S3S4) and is on the provincial Blue List. The species has no conservation protection.
Its occurrence is restricted to a small portion in the far southeast of the province, from Golden south to the USA border along the Columbia Valley in small, disjunct populations on both private and public land. Both mountain pine beetle and white pine blister rust are potential threats but detailed information on occurrence and threats/condition is lacking. Further field survey is planned for Summer 2009.

Limber pine is more abundant in **Alberta** than in BC but it is still confined to a limited portion of the southwestern foothills and mountains, from the North Saskatchewan River south to the USA border on both private and public lands.
It is currently ranked as *imperiled* (S2). In October 2008, as with whitebark pine, following the recommendation of the Alberta Endangered Species Conservation Committee, the Minister of Alberta Sustainable Resource Development approved its listing as *Endangered* under the *Alberta Wildlife Act*. As mentioned above, there are no regulations currently that permit listing of plants under the act and, thus, limber pine has no legal protection, although new legislation is expected in 2010 to permit listing of plants.
A provincial species recovery team (joint whitebark and limber pine) was formed in December 2008 and a recovery plan is expected by late 2009. The provincial status report is at http://srd.alberta.ca/fishwildlife/status/plantsinvertebrates.aspx

Limber pine's **National Status in Canada** is currently ranked by NatureServe (2007) as *vulnerable* (N3N4). Plans for preparation of a national status report are awaiting further information on conditions in BC. ■

"Cool" Shirts & Hats Showcase Whitebark Pine

Look fabulous and support whitebark pine restoration at the same time!

Don't be the last in your neighborhood to don our stylish yet functional Whitebark Pine Ecosystem Foundation logo wear. Swing into summer with a short- or long-sleeve T-shirt with our redesigned WPEF logo on the back and pocket-sized logo on front. Accessorize your outfit with a WPEF ball cap with logo on front and the slogan "*Because Blister Rust Never Sleeps*" on the back.

Shirts come in 3 colors (sage, ash, and white) and sizes S, M, L, XL, and 2XL. Hats come in 3 stone-washed colors: green-khaki, gravel (gray)-pebble, and maroon-pebble. They are adjustable so that one size fits all.

We also have our book, *Whitebark Pine Communities: Ecology and Restoration,* and beautiful whitebark pine puzzles and posters for sale. See this merchandise and order information at www.whitebarkfound.org. Better yet, come to our annual meeting this September in Nelson, B.C., and browse and purchase WPEF apparel, puzzles, etc. while you're there!

Membership Campaign offers a Reward

Shawn T. McKinney, WPEF Board Member

With each issue of *Nutcracker Notes* we read about increasing mortality of whitebark pine. As if blister rust were not peril enough, we now have exploding populations of the mountain pine beetle that are turning the high country brown. As a result of WPEF's educational efforts, the *New York Times* and other national media have publicized whitebark's plight. Unfortunately this attention and concern hasn't materially boosted membership in WPEF, which has plateaued for the last two years at about 140.

Non-profit organizations that have small memberships are at a disadvantage when applying for grants to further their mission or even in sustaining attention for their cause. To bolster our efforts in restoring whitebark pine ecosystems, WPEF's board has issued the "Whitebark Challenge 2009," which asks each of us to recruit a new member. As a reward, when you get a friend, family member, or colleague to join the WPEF this year, you'll receive a free WPEF logo cap—you choose the color. *continued on page 10*

It's simple, just take the membership form inserted in this issue of *Nutcracker Notes* to your recruit, have them apply for membership and enter your name under "Recruited By." (A "New Membership" form can also be downloaded from www.whitebarkfound.org by clicking the "Join Us" tab.) When WPEF receives the new membership application, you (the recruiter) will be contacted, asking which color cap you want, and what mailing address to use. Your new recruit will receive a beautiful bookmark adapted from Larry Eifert's iconic portrait of whitebark pine, along with the latest issue of *Nutcracker Notes* to initiate their subscription.

Members are the heart and soul of our "all volunteer" organization, and by doubling membership WPEF can double our efforts to "restore whitebark pine ecosystems." Accept the Whitebark Challenge and receive a nifty logo cap that when you wear it will draw more attention to our mission! ■

Whitebark Pine Restoration at Ski Resorts: Can it Work?

Dan Reinhart, NPS,
Yellowstone National Park, WY

One of the objectives of the Whitebark Pine Ecosystem Foundation (WPEF) has been to involve ski resorts across the western United States and Canada in efforts to restore whitebark pine. While approximately 98% of whitebark pine in the U.S. occurs on public lands, ski areas often involve a mix of private lands and U.S. Forest Service leased lands. Moreover, ski areas from Wyoming to Alberta and California to British Columbia often have whitebark pine growing on their slopes. These resorts host millions of visitors who can be made aware of whitebark pine and its contribution to the beauty and ecology of the high-country landscape. Since whitebark pine tends to be hardier than other forest trees, it is able to live on extremely rocky, windswept sites where it alone holds the soil, catches blowing snow, and anchors snow in avalanche-prone terrain, thus sustaining healthy watersheds. These characteristics make whitebark potentially well adapted to ski slopes.

WPEF has strived to engage ski resorts to become more familiar with whitebark pine and to provide interpretive materials to acquaint visitors with this special high-mountain tree and its role in sustaining animal communities and the mountain land and watersheds.

The following ski areas have participated in educational or restoration initiatives in behalf of whitebark pine:

Snowbowl Ski Area, located near Missoula, MT, has worked with WPEF on whitebark pine restoration and has ongoing projects involving their slopes.

Whitefish Mountain Resort, formerly called Big Mountain, it is located near Whitefish, MT. It has been an institutional member of the WPEF for several years and has participated in interpretive projects.

Discovery Basin Ski Area is located near Philipsburg, MT. It displays educational materials supplied by WPEF and has shown interest in a whitebark pine restoration project. .

Grand Targhee Ski and Summer Resort, near Driggs, ID, has supported Naturalist, Andy Steele's program that has conducted surveys to assess the health of whitebark pine and begin dialogue toward restoration strategies. Other initiatives include identifying Plus Trees that may be resistant to white pine blister rust, and treating these trees and other whitebark pine trees with Verbenone to protect them from mountain pine beetle attack. Grand Targhee hosts an interpretive displays and naturalist talks that explain the importance of whitebark pine, and the resort uses whitebark pine conservation as part of their ski area's greening initiative.

Jackson Hole Mountain Resort, at Jackson Hole, WY, is an internationally known attraction. The resort has welcomed WPEF and allowed it to initiate surveys to assess the health of whitebark pine and begin dialogue toward restoration strategies.

Whistler Ski Resort, near Vancouver, B.C. and site of the upcoming 2010 Winter Olympics, has hosted whitebark pine restoration efforts conducted by the Whistler Naturalists organization for several years (see *Nutcracker Notes*, No. 9, pp. 15-16, fall-winter 2005, accessible at www.whitebarkfound.org)

Big Sky Resort, located south of Bozeman, MT,

has recently become a member of WPEF, and has expressed interest in possible restoration activities on its lands.

Other ski areas that have hosted or considered whitebark pine restoration activities include Mount Ashland Ski Resort, Mount Hood Ski Bowl, and Mount Hood Meadows in Oregon; and Crystal Mountain Ski Resort in Washington.

WPEF will continue to outreach to ski resorts that include whitebark pine habitat and could serve as sites for public education and restoration activities. We have provided ski resorts with attractive indoor and all-weather outdoor poster displays about whitebark pine. WPEF affiliated scientists can consult with ski resort staff and the local national forest ski area liaison to consider potential whitebark pine restoration activities that might be appropriate at a given ski area.

Ski resorts are increasingly interested in demonstrating that they can be good environmental stewards. In 2008, WPEF and the Greater Yellowstone Coordinating Committee's Whitebark Pine Subcommittee attended a business partnerships workshop to discuss how businesses including ski resorts can contribute to sustaining whitebark pine. WPEF's collaboration with ski areas and managers of associated public lands can benefit all parties as well as whitebark pine ecosystems. WPEF members who are interested in helping with our ski area initiative are invited to contact this author (Dan_Reinhart@nps.gov) or one of the WPEF officers or board members listed on the inside cover of this magazine. ■

Interview with Bryan Donner, WPEF's Membership Coordinator

Editor: What caused you to first recognize that whitebark pine and its associated ecosystems warranted special attention?

Donner: Bob Keane's efforts to survey the extent of blister rust infection in the Bob Marshall Wilderness Complex in the early 1990s was my first exposure to the fascinating circumstances regarding whitebark pine's unique place in the ecosystem and the challenges the species has in maintaining that place. Bob invited me in the summer of 1991 to backpack for ten days through the wilderness and assist him in collecting blister rust information. I accepted, and after learning about the importance of whitebark pine to wildlife and the high-mountain environment, I took up the cause of helping restore whitebark pine ecosystems.

Editor: What changes have you observed in whitebark pine ecosystems?

Donner: I first began closely observing whitebark pine ecosystems in northwest Montana in the early 1990s. Most of the high elevation forests at that time contained a mix of live, mature whitebark pine and a large number of whitebark pine snags that had been standing dead for many years. The number of live, mature trees has steadily declined as mountain pine beetle and blister rust have taken a continuing toll.

One consequence of the decline of cone-producing trees is a diminishing amount of seedling regeneration resulting from unrecovered nutcracker caches. Fifteen to twenty years ago, I noticed new seedlings were growing in recently disturbed areas such as timber harvest and road construction operations. Today, very few new seedlings are seen in areas like this.

Many of the losses of cone producing trees are, of course, attributed to blister rust and pine beetles, but there also has been a significant loss of cone producers from recent large-scale, high-intensity wildfires. These fires typically start at high elevations and sweep along ridges, killing many of the mature trees that may have had some natural resistance to blister rust.

Editor: What outreach and educational efforts have you used to enhance knowledge and concerns about whitebark pine by the public and natural resource specialists?

Donner: I helped organize several workshops and symposia dedicated to whitebark pine outreach and educational efforts. The first was a one-day workshop I organized with Kate Kendall in Glacier

National Park in 1994. In 1998 I was in charge of organizing field trips for a large whitebark pine symposium in Missoula.. In 2004 I helped organize the workshop in West Yellowstone that presented methods for gathering standardized survey data on whitebark pine forests. I am currently involved in planning the major symposium on high-elevation white pines in 2010 (see separate announcement).

I helped recruit Whitefish Mountain (formerly "Big Mountain") Ski Resort as an active supporter of WPEF's mission, and helped supply the interpretive information the resort employs to educate its visitors about whitebark pine.

I petitioned WPEF's board to create a position called Membership and Outreach Coordinator, and then agreed to fill that position to focus on increasing our membership and serving members.

Editor: Historical observations cite whitebark pine cone crops as an abundant food source for wildlife in northwestern Montana. What is the situation today?

Donner: As the number of cone producing whitebark pine decreases, most cones today are harvested by the Clark's nutcracker and consequently there are few cones available to be cached by the red squirrel. Squirrel caches are rarely found in Northwest Montana today and grizzly bears are no longer able to use pine nuts as a major food source.

Editor: What activities have the Flathead NF focused on for restoring whitebark pine?

Donner: Our first efforts in the late 1980s and early 1990s were to create Clark's nutcracker caching opportunities through broadcast burning high elevation areas. We continue to prescribe burn today but are trying to incorporate measures that allow for more of the existing whitebark pine cone-producers and potential cone producers to survive the burning activity.

We have also conducted cone collections when good crops have produced enough cones for both us and the nutcrackers. Seedlings grown from these collections have been outplanted in some of the broadcast burns, wildfire areas, and at least one timber sale area. Most of our prescribed burning is now conducted with a prescription calling for subsequent planting of whitebark pine seedlings.

The Flathead NF has also contributed seed to the tree improvement programs aimed at selecting for rust resistance and eventually creating operational seed orchards. We have identified genetic plus trees (apparently resistant to blister rust) across the forest and will be protecting these trees from pine beetles by treating them with verbanone or carboryl. ■

Grizzly Bear Use of Whitebark Pine Seeds in the Willmore Wilderness Park, Alberta

Tracy McKay and Karen Graham,
Foothills Research Institute, Hinton, Alberta

In the spring of 2008, Alberta Parks initiated a project with the Foothills Research Institute (FRI) Grizzly Bear Program (GBP) to investigate possible grizzly bear use of whitebark pine seeds as a food source in the Willmore Wilderness Park, near the northern limit of whitebark pine distribution in Alberta. Willmore Park is situated in the Rocky Mountains along Alberta's western border (at about 53 deg. 30 min. N. latitude), immediately north of Jasper National Park.

In the Greater Yellowstone (Park) Ecosystem (GYE), whitebark pine (WBP) seeds are an important food for bears, and almost all seeds eaten by bears are obtained from digging up red squirrel middens (Mattson & Reinhart, 1997). In Alberta, whitebark seeds have not been reported as a significant bear food (e.g. Russell et al., 1979; Hamer & Herrero, 1987; Munro et al., 2006). However, none of the study areas have specifically considered whitebark pine stands. Grizzly bears are known to eat a wide variety of foods, and foods vary by region. Based on the relative abundance and health of whitebark pine in the Willmore, and the lack of specific research investigating whitebark pine and bear foods in this area, it was conceivable that a relationship could exist between WBP and grizzly bears.

Some basic research questions were developed for the 2008 field season:

Are WBP seeds available for bears in the Willmore?
What is the density of WBP trees? Do red squir-

rels build middens in the WBP stands in the Willmore? What is the midden density (middens per hectare)? Are squirrels caching WBP cones at middens?
Are bears eating WBP seeds in the Willmore?
Is there evidence of bear activity and WBP use at squirrel middens?
How much? What is the relative importance of WBP in the diet?

Methods

We completed transect surveys in whitebark pine stands in four different areas of the Willmore to search for squirrel middens. We collected midden data, estimated WBP densities, and investigated grizzly bear activity at squirrel middens. The middens and surrounding areas were searched for signs of bear activity, such as diggings (midden excavations) or bear scat. All bear scat found along transects and at middens was examined in the field, the estimated age of bear scat was recorded, and representative samples were collected. In the lab, scat samples were dissected to identify food items and estimate percentages of food items by volume.

Results and Discussion

Whitebark pine densities (basal areas) measured in two of the study regions were 3.16 and 7.33m^2/hectare (14 and 32 sq. ft./acre). These basal area values are in the general range of those observed in regions of documented bear WBP use in the GYE.

Red squirrel middens were observed along half (8/16) of the midden transects completed; a total of 17 middens were located, confirming that red squirrels do inhabit the high elevation WBP stands in the Willmore. Midden densities (0 to 1.50 active middens per hectare) observed in this study were similar to those previously reported in white spruce and lodgepole pine forests in Alberta (Wheatley et al., 2002), but higher overall than those reported in other studies of WBP stands (Mattson & Reinhart, 1996). Differences in midden densities could reflect differences in stand composition between the Willmore and Yellowstone and may also have been affected by the small areas sampled during this pilot project. Further study of midden densities in WBP stands could help determine how stand characteristics may affect squirrel densities, and help characterize WBP stands that are more likely to provide bears with WBP seeds.

Intact whitebark pine cones were cached on the surface at only one out of the seventeen middens sampled (6%), but WBP cone scales were present at most (88%) of the middens. The presence of WBP cone scales confirms that squirrels are collecting and using WBP cones in the Willmore, potentially making WBP seeds available for bears. The low number of WBP cones cached at the middens is probably due to the low availability of WBP cones in the Willmore in 2008; cones were few or absent on WBP trees at the sites studied.

Midden excavations and bear scat were found at eight of the seventeen (47%) middens. From field observations, WBP seed casings (seed coats) were visible in 35 of the 38 (92%) bear scats found. Analysis in the lab confirmed that WBP was present; some scats were 100% WBP. Based on this evidence, it can be concluded that bears are eating WBP seeds in the Willmore area. It is difficult to calculate the relative importance of WBP seeds in the overall diet of grizzly bears in the Willmore, since scat samples were only collected along transects, and only during one field season. Excavated midden densities varied among the four study areas in this project, suggesting that bear use of WBP might differ between different parts of the Park. All diggings and scat appeared to be from the previous year (2007) or older, implying no bear use of WBP in 2008.

Conclusions

Previous research in Alberta has not reported WBP seeds as a significant food source for grizzly bears, but research has not focused on whitebark pine stands. If whitebark pine seeds are a significant grizzly bear food, the loss of WBP trees through blister rust or pine beetle could affect the reproduction and survival of grizzly bears. Our Grizzly Bear Program plans to continue this research during the 2009 field season, expanding the study area to include more areas in west-central Alberta. Collecting more data will allow better understanding of the relative importance of WBP seeds for grizzly bears, differences in availability of WBP seeds and levels of bear use between different regions of WBP distribution, and predictor variables for WBP availability and bear use. If different regions within WBP distribution support different levels of bear use of pine seeds,

this information could assist prioritization of WBP conservation efforts and/or influence bear conservation strategies.

Acknowledgements

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What Happens to Tree Resources when Bark Beetles Attack?

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I became interested in the interaction between whitebark pine and the mountain pine beetle almost accidentally. I started my Ph.D. research at the University of Montana intending to look at resource allocation in whitebark pine--how trees use nitrogen, phosphorus, and carbon for growth and reproduction, particularly during years of high cone production. Unfortunately, a site where my advisor had monitored tree resources for several years was hit hard by the mountain pine beetle in 2006. Non-structural carbon compounds like sugars, starch, and lipids, accumulate in tree sapwood when the products of photosynthesis exceed the demands by growth or other functions, or when environmental factors such as cold temperature limit growth or other functions. Analysis of samples collected in 2006 from beetle-attacked trees showed a dramatic depletion of sapwood non-structural carbon. Carbon levels were lower than those prior to the attack and also lower than those measured in healthy trees.

The decline in tree *sapwood* non-structural carbon was surprising because mountain pine beetle larvae develop entirely in tree *phloem*, the thin layer of tissue under the bark of the tree, and they have no direct access to the tree's sapwood. However, symbiotic fungi occurring alongside the beetle extend hyphae throughout the phloem and sapwood of the tree, and are known to concentrate tree nutrients like nitrogen (Ayres et al. 2000, Bleiker and Six 2007). This decline in sapwood carbon compounds suggests that through its fungal partner, the mountain pine beetle may access a previously unrecognized food source, in the sapwood. Furthermore, tree non-structural carbon content may be an important and overlooked aspect of host tree nutritional quality, and may in turn influence mountain pine beetle performance.

As a result of these findings, I decided to study how host tree physiology and carbon storage influence the interaction between the tree, mountain pine beetles, and the beetle's fungal partners. Two

general questions that I address are: 1) Is carbohydrate depletion due to beetle or to fungal consumption of tree tissue? and 2) Why does carbohydrate depletion occur?

To investigate these questions, in 2008 I took sapwood samples from mixed whitebark pine-lodgepole pine stands in the early stages of a mountain pine beetle outbreak, in two areas of southwestern Montana. A significant depletion of sapwood non-structural carbohydrates occurred in attacked versus healthy whitebark pine trees ($p<.001$, ANOVA). However, this depletion only occurred in trees with extensive fungal colonization of the sapwood; trees with minimal fungal colonization of the sapwood did not differ from healthy trees. A similar trend occurred in lodgepole pine.

These data suggest that depletion of carbohydrates requires the presence of fungal hyphae in the tree sapwood. It is not yet known whether sapwood carbohydrates directly benefit beetle performance, or indirectly benefit the mountain pine beetle by supporting the growth of its symbiotic fungal partner. I hope to tease these factors apart in ongoing experiments. The use of nitrogen and other nutrients in beetle and fungal growth is also poorly understood and is under current investigation. My observations thus far indicate that the mountain pine beetle and its fungal partners benefit from sapwood carbohydrates, and suggest that tree nutritional quality may influence beetle performance and the dynamics of mountain pine beetle outbreaks in whitebark pine stands. ■

Relationship between Whitebark Health and Clark's Nutcrackers Visits

Lauren Barringer and Diana Tomback
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Whitebark pine (*Pinus albicaulis*) in the northern Rocky Mountains is declining as a result of *Cronartium ribicola*, the invasive pathogen causing white pine blister rust, and also from ongoing outbreaks of mountain pine beetle (*Dendroctonus ponderosae*). Clark's nutcracker (*Nucifraga columbiana*) is the primary seed disperser for whitebark pine. Previous work shows that nutcrackers make fewer visits to damaged forests than to healthier forests when seeds are ripe. (McKinney and Tomback 2007, McKinney et al. 2009). If nutcrackers are not visiting whitebark pine in heavily damaged stands, natural regeneration will diminish greatly.

We tested published predictions relating live trees and cone production to the likelihood of nutcrackers visiting whitebark pine (McKinney et al. 2009). We worked in four national parks--Grand Teton, Yellowstone, Glacier, USA, and Waterton Lakes, Canada

Materials and Methods

Three 1 km x 30 m nutcracker-monitoring transects were established in stands of mature whitebark in Glacier NP, two in Waterton Lakes NP, two in Yellowstone NP, and two in Grand Teton NP. Transects were monitored twice in July and twice in late August, 2008. Each transect has 6 nutcracker point count stations, one every 200 m, and each point count required 10 minutes. Point count data will be supplemented in 2009 with information on nutcracker sightings, activities, and tree preferences gathered off transects. Two 50 m x 10 m plots were established at a randomly generated point adjacent to each monitoring transect to survey stand structure, blister rust infection and canopy damage, mountain pine beetle symptoms, tree mortality, and whitebark pine regeneration. Cones per tree were counted on each plot in July and again in late August. These protocols will be followed again in 2009.

Results (2008 field season)

Ten transects and 20 forest health plots were successfully installed across all four parks. Whitebark pine in Glacier and Waterton Lakes National Park has the highest overall average blister rust infection level (33% and 70%, respectively) (Fig.1). Mountain pine beetle infestation was highest overall in Grand Teton National Park at 34.1% of trees (Fig. 2), although the Avalanche Peak area in Yellowstone National Park was much higher. The highest percent dead whitebark pine occurred in Glacier National Park (37.5%), although Grand Teton and Waterton Lakes National Parks were high as well (36.5% and 33.3%, respectively) (Table 1). The highest density of living trees was found in Yellowstone National Park, with low densities in Glacier and Waterton Lakes National Parks (Table 1). Average nutcracker occur-

rence was highest in Yellowstone National Park, and lowest in Waterton Lakes National Park (Table 2).

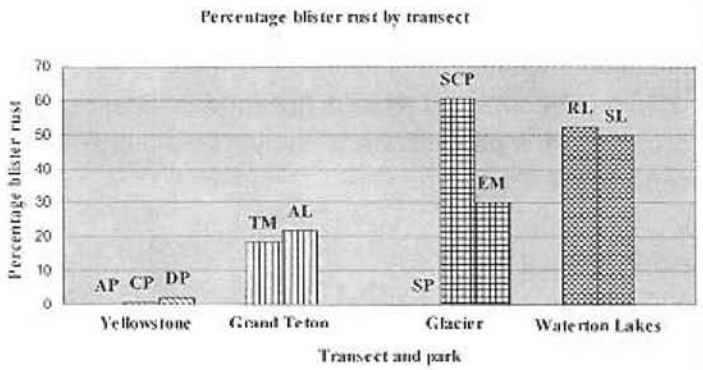

Figure 1. Percentage infection by blister rust by transect and national park. Each bar is named for the trail or area where the transect and plots were placed.

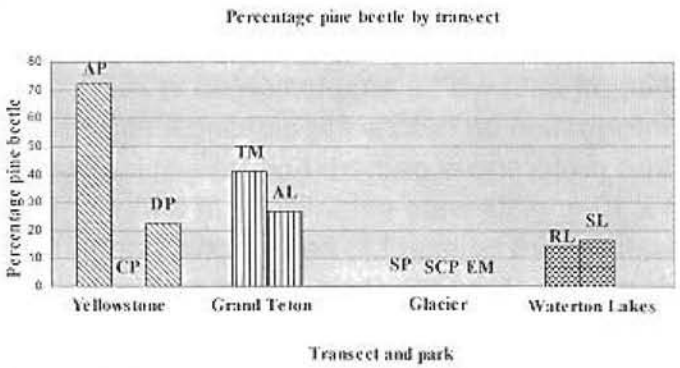

Figure 2. Percent of trees infested by pine beetle by transect plots and national park.

Average per park	Yellowstone	Grand Teton	Glacier	Waterton Lakes
Percentage dead whitebark	17.9%	36.5%	37.5%	33.3%
Living whitebark density	0.076 per m^2	0.027 per m^2	0.008 per m^2	0.009 per m^2
Cones per park subplot	24.8	5	2	0

Table 1. Percentage of dead whitebark, and living whitebark density. Data are overall means among all transect health plots within a national park.

Nutcrackers observed on point counts	Yellowstone	Grand Teton	Glacier	Waterton Lakes
High count of 6 point counts	9	9	1	1
Average among 6 point counts	5.6	7	0.33	0.50

Table 2. Nutcrackers observed on point counts

Discussion

Whitebark pine health is generally poor throughout the species' range. Declines are occurring across all four parks from blister rust infection and mountain pine beetle outbreaks. Blister rust is highest in Waterton Lakes NP; there, cone density is lowest. Overall, 2008 was a poor cone year; 2009 appears likely to yield better cone production across the Central and Northern Rocky Mountain Region. Not surprisingly, cone production was highest where live tree density was highest. Nutcracker counts paralleled cone production numbers, with observed nutcracker numbers highest in areas with high whitebark density and cone counts. Similarly, areas where whitebark is much reduced were also areas with fewer nutcrackers.

We will be repeating cone counts and nutcracker point counts in 2009. Once we have obtained those data, we anticipate using a rigorous data analysis protocol for both years across all four parks. If the count trends obtained in 2008 hold across the parks in 2009, the results will generally support the conclusions of McKinney et al. (2009), who documented fewer nutcracker seed dispersal visits in late August and early September to whitebark pine in Glacier NP than in other areas with lower whitebark pine damage and mortality. If our initial findings are confirmed in 2009, this would support McKinney et al.'s (2009) suggestions that active management in the Northern Continental Divide Ecosystem is indicated in order to maintain whitebark pine communities, given the lower probability of seed dispersal services available from nutcrackers.

Acknowledgments

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Modeling the Spread of Blister Rust in the Greater Yellowstone Ecosystem

Jaclyn A. Hatala, Univ. of Calif., Berkeley, and Robert L. Crabtree, Yellowstone Ecol. Res. Center, Bozeman

Summarized from: Hatala, J.A., M.C. Dietze, R.L. Crabtree, the Interagency Whitebark Pine Monitoring Working Group: K. Kendall, D. Six, and P. R. Moorcroft. 2009. An ecosystem model of white pine blister rust spread in whitebark pine throughout the Greater Yellowstone Ecosystem. In preparation.

Introductions of nonnative pathogens are playing an increasing role in the scale, magnitude and persistence of disturbance regimes in the forests of the western United States. In whitebark pine (*Pinus albicaulis*) forests of the Greater Yellowstone Ecosystem (GYE), white pine blister rust (*Cronartium ribicola*), is now a primary source of mortality at high elevations (Kendall and Arno 1990). This pathogen has two obligate alternate hosts, five-needled pines and shrubs in the genus *Ribes*, and was introduced to North American in 1910 near Vancouver, B.C.. Despite a continental-scale federal program to eradicate white pine blister rust that began in the 1930s and continued for three decades, to this day blister rust still pervades five-needled pine populations within much of the western United States (Smith and Hoffman 2000).

Due to the failure of control efforts, there is interest in predicting the impacts of blister rust and other forest disturbances on whitebark pine in the future. Our study combines data from five different field monitoring campaigns through data collected by the Interagency Whitebark Pine Monitoring Working Group, Katherine Kendall with USGS, the National Park Service (Yellowstone N. P.), Diana Six at the University of Montana, and the Yellowstone Ecological Research Center. Our combined dataset spans the years 1968-2008 and comprises 121 high-elevation whitebark pine sites. Using this extensive dataset, we employed Bayesian statistics to create a blister rust infection model for these field sites located throughout the GYE. Our model computes the rate of blister rust spread over time (the past) based on both site-specific and global parameters in order to project the future impact of blister rust.

Our analysis models the transitions between four classes of white pine blister rust infection in whitebark pine populations: susceptible, slightly infected (any small sign of blister rust infection), moderately infected (significant red/dead flagging and/or girdling bole cankers), and dead. After the field data was sorted (divided?) into these four infection classes to simplify the analysis, our model uses the field data to compute the proportion of the stand at each field site within each infection class, and then parameterizes the transition rates between the four classes at a yearly time-step. Because individual trees were not tagged in most of the initial field censuses, there is a substantial uncertainty regarding the ability to relocate individual trees between census years, and thus proportions at the 'stand-level' in each of the four classes are modeled instead of individual trees.

Since whitebark pine trees exist only at high elevations throughout the GYE, patches of whitebark pine exist at distances where it becomes insightful to analyze both local and global infection dynamics through a metapopulation structure. Using the Bayesian blister rust infection model, and then parameterizing it based on our field data, we tested four hypotheses for the dynamics of mechanistic infection of blister rust operating at the ecosystem scale: blister rust infection is independent of infected tree density, blister rust is proportional to the local (site-level) infected tree density, blister rust infection is proportional to the global (ecosystem-wide) infected tree density, or blister rust is proportional to both the local and global infected tree density. Figure 1 demonstrates the four 'test case' model outputs for the four blister rust infection classes at one site in the GYE from 1968-2008.

By evaluating the four possible models of the blister rust infection dynamic through the predictive loss criterion (a Bayesian metric for assessing how well the model fits the data and predicts into the future), we found that the model where blister rust infection is proportional to both local and global infected tree density scored the best fit. This supports the 'density dependence' theory that both local infection and a global infection play an important part in the spread of blister rust in whitebark pine within the GYE.

From the results of the output from the best fit model, we calculated the average residence times for the blister rust disease in whitebark pine within each of our three infection categories: susceptible, slightly infected and moderately infected. Our analysis indicates that on average across all sites, stands of whitebark pine take 6.7 years to transition from uninfected to infected, 10.9 years to transition from slightly infected to moderately infected, and 9.4 years to transition from moderately infected to dead. The residence times of the slightly infected and moderately infected stages indicate that on average in our dataset, it will take infected trees at the field sites throughout the GYE an average of 20.3 years to die. These numbers can serve as an informative parameter for forest managers in the GYE who might use these numbers to inform management decisions of whitebark pine forests.

Results of this study can be utilized by forest managers to track that rate of disease spread within sites, as well as globally throughout the ecosystem. It might be used to identify sites with slow rates of disease progression, which might indicate some genetic resistance within certain populations. Additionally, the results might help to inform reforestation efforts in areas that might be environmentally less suitable for blister rust. The basic formulation of this model could be applied to other multi-stage plant diseases, where managers have an interest in monitoring disease progression at individual sites as well as large-scale ecosystem-wide levels of the disease. Finally, our basic mechanistic 'spread' model can be modified to include the interaction of bark beetle and blister rust to project rates of overall mortality in whitebark pine.

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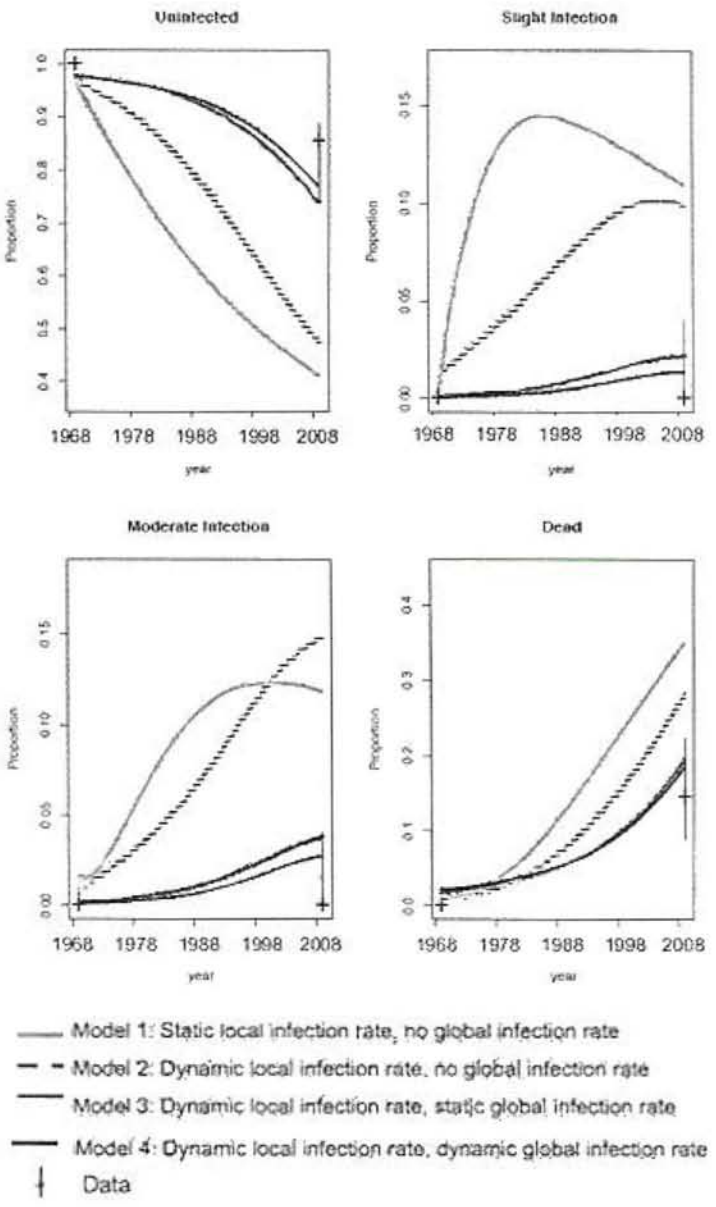

Figure 1. In this figure, the four graphs represent the four infection classes in our model: susceptible, slightly infected, moderately infected, and dead. Within each graph, the four colored lines represent the four 'test case' infection model outputs at one field site in the GYE from years 1968-2008. Across all 121 sites included in our model evaluation, Model 4, which includes terms for dynamic local and global blister rust infection, performs the best. ■

Gone Missing: The Curious Case of Whitebark Pine In the Great Burn Country

Steve Arno

The infamous Great Idaho Fire(s) of 1910 destroyed whitebark pine stands across a broad swath of the remote, rugged Bitterroot Mountains in northern Idaho and the adjacent western edge of Montana, including many trees over 300 years old that had survived previous fires. Strangely, although whitebark pine is considered to be "adapted" to fire, it failed to recover from the 1910 holocaust. Instead, whitebark is now represented by ghostly snags, fallen and standing (see photos on back cover). On the more moderate sites lodgepole pine, subalpine fir, and Engelmann spruce have replaced a pre-1910 mixed forest featuring whitebark pine. However, the highest ridges and peaks have been converted to stony heath-land (*Phyllodoce, Carex, Juncus,* etc.) where only a few scattered young trees arise among the sun-bleached, fallen remnants of the former whitebark pine forest.

Similarly scorched high ridges and peaks (>7000 feet in elevation) extend along much of the Idaho-Montana Divide from the head of Trout Creek, southwest of Superior, MT, southward 40 miles, past Lolo Pass to Grave Peak and then 40 miles southwestward to the Selway-Lochsa Crags near Lowell, ID. From promontories all across this area an observer scans barren ridge-tops and ponders why whitebark pine failed to re-establish. Perhaps identification of the factors causing its virtual disappearance in the Great Burn country would aid understanding and mitigation of current threats to this ecologically important tree throughout its natural distribution. I'll present some observations made in several visits to the Great Burn high-country, hoping to encourage detailed study of whitebark's plight here—which has not so far been attempted.

Hiking up one of the drainages that arise along the Idaho-Montana divide, at first the route passes through a mixed forest featuring centuries-old western larch. Soon, however, it enters the 1910 burn, now populated by dense young stands of lodgepole pine, larch, and other species. In damp areas, century-old burned snags of western redcedars four feet thick stand out as ghostly sentinels, but despite an abundance of other young trees, very few young cedars are seen, even along the creek itself. Is cedar's mysterious disappearance in some way related to that of whitebark pine which once covered the largely-barren ridges that tower above?

Perhaps the failure of whitebark pine to recover is related to "double" or "triple burns"--re-burns in 1917, 1919, 1926, or 1934--that swept some of this country, and can be roughly documented from fire atlases maintained by the Lolo and Clearwater National Forests. Was soil degradation a factor? (See photo on the back cover.) Perhaps the vast landscape-scale destruction of whitebark pine here prevented Clark's nutcrackers from caching seeds throughout the burned area. Did the throngs of domestic sheep that summered in this high-country during the early 1900s contribute to a failure of whitebark pine regeneration? White pine blister rust entered northern Idaho by the 1930s coinciding with a massive mountain pine beetle kill of mature whitebark pines throughout the region; did these events contribute to whitebark's failure to re-establish?

Anyone interested in exploring this whitebark pine conundrum would be well advised to contact the Great Burn Study Group (GBSG), a non-profit organization established in 1971 to study and promote conservation this wild country. The GBSG sponsors volunteer crews that document conditions in the area and conduct restoration efforts such as treatment of invasive species. In consultation with Forest Service specialists, the GBSG is currently surveying whitebark pine's distribution and blister rust infection in the Great Burn country, and would like to encourage research that could aid restoration of whitebark pine. For more information, contact GBSG Policy and Field Studies Director, Beverly Dupree at 406 240 9901 or thegreatburn@yahoo.com. ■

REGISTRATION*

Please email or phone to reserve your space. Choose Speaker Program and/or Field Trip.
michael.murray@gov.bc.ca 250-354-6312
***Tentative $10 fee at-the-door**

WHERE TO STAY

Hotel: Summer vacancies can be rare in popular Nelson. A block of rooms is reserved at the **Best Western Baker Street Inn** (www.bwbakerstreetinn.com). Call 1-888-255-3525 and ask for 'Whitebark Pine' rate ($85 Canadian funds/single, $95/double).
Hostels: www.dancingbearinn.com and www.white-house.ca
Camping: A municipal campground w/hook-ups,showers, etc. is walking distance from venue. campnels@telus.net

AIRPORT: www.castlegar.ca/airport.php

CROSSING THE BORDER: Travelers returning to USA will need an enhanced DL, passport or cheaper passport card. Apply early! www.getyouhome.gov

Whitebark pine trees killed by 1910 fire on a harsh site--see "Gone Missing" article. Note erosion, and that the patchy 90-year-old replacement stand has few whitebark.
(photos by S. Arno)

Large whitebark pines (fallen trunks) made up the forest that burned in 1910. New stand on this moderate site is nearly pure lodgepole pine.