Spring | Summer 2004

Nutcracker Notes

Whitebark Pine Ecosystem Foundation

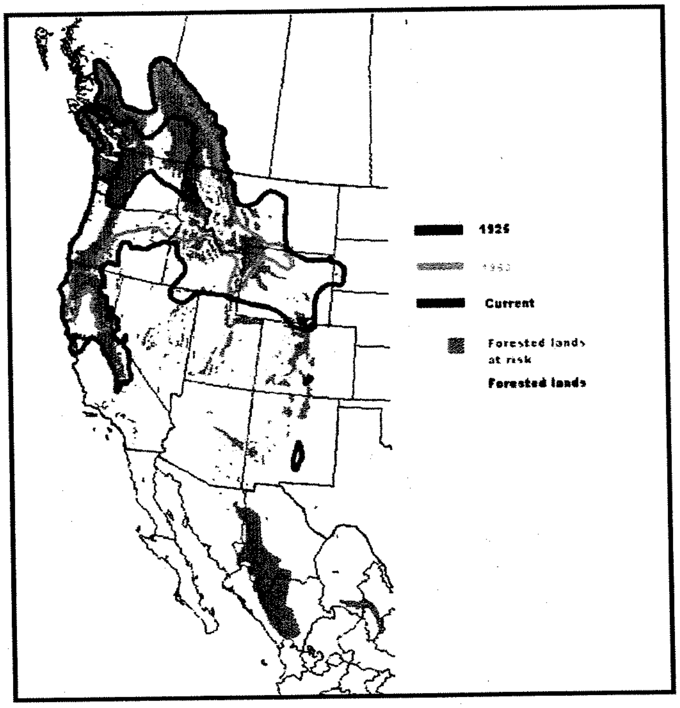
Issue 6

Topics

WPEF
P.O. Box 16775
Missoula, MT
59808

What We're Doing About Blister Rust

Spread of White Pine Blister Rust In Western North America 1910 to 2003



Ancient whitebark pines killed by blister rust, east of Beaver Ridge Lookout, Clearwater National Forest. Photo by Steve Arno.

Whitebark Pine Ecosystem Foundation's Mission

Counteract the decline of whitebark pine, a keystone species of high-mountain ecosystems in western North America

Director's Message

Diana Tomback
Director of the Whitebark
Pine Ecosystem Foundation

As non-profit environmental-advocacy organizations go, the Whitebark Pine Ecosystem Foundation at three years of age is a toddler, with lots of energy, enthusiasm, dedication, but still cruising up the learning curve. Although not all our ideas and plans work, many do; and, for such a youngster, we are making good progress.

For example, the workshop, "Monitoring whitebark pine for blister rust," June 28-30 at the Holiday Inn, West Yellowstone, Montana, promises to be a major success! The workshop has reached its capacity with 80 registrants, and a waiting list. The support and enthusiasm of the invited speakers and volunteer field instructors has been truly gratifying. We now have a teacher to student ratio of better than one to four for the field portion of the workshop. The experts and support staff deserve our many thanks for generously donating their time to this effort. We also owe thanks to Debbra Graham of Continuing Education, University of Montana, for her hard work organizing the workshop, as well as to our sponsoring organizations (see accompanying article) for standing by us after the workshop was postponed because of last year's raging fire season. We scheduled the workshop early this year to be ahead of any fire season—let us all hope.

The basic objectives of the workshop are to (1) teach the symptoms of white pine blister rust as they appear in whitebark pine and (2) present a practical and efficient set of methods for surveying and monitoring blister rust incidence and tree damage and mortality. Our intent with these methods is to standardize data collection, focusing on a minimum number of critical variables, in order to allow meaningful comparisons within and between geographic regions. Built into the methods are also suggestions for additional kinds of data collection for research purposes. In addition, a software database was specifically designed for the WPEF methods by Brent Frakes and other colleagues at the National Park Service; we hope to have the software on CD and available at the workshop. We are encouraging participants to use the methods to survey and monitor whitebark pine stands rangewide. With whitebark pine stand health assessments within a national forest or park, management should be able to prioritize areas for restoration or, if blister rust levels are still low, plan for future restoration efforts.

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Announcing WPEF's Annual Meeting: Waterton Lakes National Park; September 24-26, 2004

All WPEF members and other people interested in whitebark pine are invited to our first annual meeting to be held just across the border in Alberta's Waterton Lakes National Park. Our host and chief of operations is WPEF Board Member Cyndi Smith, Parks Canada Conservation Biologist stationed at Waterton. Waterton Lakes is only about a 2½-hour drive from Kalispell via Going-To-The-Sun Road in Glacier Park, and alternative or loop trips are feasible using U.S. Highway 2 (Marias Pass) or Canada's Highway 1 via Crow's Nest Pass. See map on back cover and mark your calendar. Please check our web site (www.whitebarkfound.org) during summer for updated information on the meeting and accomodations.

Friday, September 24, 2004

2:00 p.m. – 5:30 p.m.: **Board of Directors** meets in Parks Canada Boardroom
Early evening wildlife viewing: Drive to Blakiston Fan to see and hear bull elk bugling and sparing.
Supper: WPEF board, members, and visitors join for group dinner at local restaurant.

Saturday, September 25, 2004:

1:00 p.m. – 5:00 p.m.: **General Meeting** and Science Updates will be held at the Waterton Park School. It is open to members and non-members. Agenda will include:

- Message from Director
- Update on Foundation activities
- Other Foundation business
- Invited presentations on whitebark and limber pine

Sunday, September 26, 2004:

8:00 a.m. – 5:00 p.m.: Meet at Waterton Park Firehall to arrange transportation.

Car pool to Cameron Lake (1/2 hour drive), and hike 1-1/2 hours to Summit Lake, an area of whitebark pine with high blister rust mortality which Parks Canada has designated for a prescribed burn. Focus of the hike would be on Bob Keane discussing what could be done at the site through mechanical treatment, protection of seed trees, etc., to prepare it for a more successful burn. At this time of year the alpine larch should be peaking in colour.

Option A: Those who are energetic can continue on the Alderson-Carthew Trail, hiking back to Waterton townsite. The trail continues up over an alpine ridge, then past the Carthew Lakes and Alderson Lake. This is one of the most popular day hikes in the park. The distance is 17 km from Cameron Lake to the townsite. Car shuttles would need be set up when we meet in the morning.

Option B: Return to Cameron Lake by noon and drive ¾ hour to the Horseshoe Basin Trailhead and hike 1 hour to an area of limber pine, also with blister rust. Lower part of the hike would be through aspen poplars, which should also be in peak colour (if the leaves haven't all blown off in the infamous Waterton winds). The trailhead is near the Bison Paddock, and folks could take a sidetrip through there after the hike. Option B also allows folks to leave immediately after returning to Cameron Lake if they need to start driving home.

Other activities:

Late September is an especially good time for wildlife viewing in the park: black and grizzly bears are feasting on saskatoon berries (serviceberry) and Rock Mountain elk are battling for supremacy. Plan to spend an extra day or two in the park to enjoy these activities.

How to get there:

Check the WPEF website (www.whitebarkfound.org) for maps on how to get to Waterton Park, how to find the School and Firehall, and lists of accommodation. Cyndi Smith will field questions via e-mail: Cyndi.Smith@pc.gc.ca

Funding Available for Restoration Projects

Diana F. Tomback

The WPEF is soliciting proposals for whitebark pine restoration projects targeted for summer 2005. We hope to provide matching funds of $2,000-$5,000 for each of three to five short-term projects in regions where whitebark pine is heavily impacted by white pine blister rust and/or successional replacement.

Here are our plans: We will select a group of the most feasible and urgent projects of the pool and use them collectively to write an umbrella proposal. We already have an offer of partial funding from the Albert and Tricia Nichols Foundation, which would serve as matching funds. The WPEF would contribute another $3,000. The proposal format is as follows:

- Title, proposing agency, and contact information
- Justification of project (very important)
- Location of project
- Project description, include size of area to be treated and methods used
- Overall project budget, and requested budget
- Source of other funds (in addition to contribution from WPEF)
- Likelihood of project completion in 2005, if funded Funding may be requested for silvicultural thin ning, prescribed fire, collecting seeds, growing and plant ing seedlings, or other aspects of restora tion.

The proposals should be about 7 to 10 pages in length, single-spaced. Please send them to the WPEF by October 1, 2004. We will prioritize the proposals and write our umbrella proposal for a deadline by the end of the year. We should know whether we are successful in our fund-raising efforts by late winter, 2005. This should provide adequate time for planning for those proposals we select to fund. For more information, check WPEF's web site (www.whitebarkfound.org) after June 15th. ■

Forest Plan Revision: Your Chance to Speak Out for Whitebark Pine

Susan Rinehart, Asst. Regional Botanist
USDA Forest Service, Missoula, MT

Editor's Note: This article pertains to the USDA Forest Service's Northern Region. Nutcracker Notes *welcomes similar articles about how to influence planning for whitebark pine restoration in other national forest regions, national parks, and Canadian provincial forests.*

Do you want to make a difference in the management of whitebark pine over the next 15 to 20 years? The Forest Plan Revision process currently being conducted in the national forests of Montana and northern Idaho provides the venue to upgrade efforts to restore whitebark pine. These national forests invite comments and suggestions for land management during their planning process, a not-to-be-missed opportunity for those who have concerns and recommendations for whitebark pine management across the region or in a specific mountain range. Decisions made during the planning process help focus the budgetary expenditures of the agency and would help prioritize funding for whitebark pine restoration.

To be most effective in providing comments to a Forest planning team, citizens should attend one of the numerous open houses conducted by a nearby national forest and talk to vegetation specialists or district rangers. Questions you may want to ask include: How much whitebark pine exists on the Forest? How much existed prior to settlement? And, what measures are being taken to restore the species?

Another important method of communicating with Forest planning teams is to submit written comments with questions and recommendations concerning whitebark pine management and restoration. Although it is most effective to submit these written comments during one of the open comment periods that occur regularly during the planning process, written comments can be submitted anytime the Forest is undergoing revision. You may want to ask the plan-

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Whitebark pine conservation in a managed forest, British Columbia

Brendan Wilson, Selkirk College, Castlegar, B.C.

For the past several years I have been working on whitebark pine conservation issues in the Arrow Forest District in southeastern British Columbia. The main focus of this work is to develop an adaptive management approach to maintaining whitebark pine recruitment in a managed forest where timber extraction has replaced fire as the primary forest disturbance; and increasing mortality due to blister rust infection and pressure from competitive shade-tolerant trees threatens the species' long-term viability.

My general approach has been to document topographic features, stand structure, and fire disturbance history within the region's unharvested subalpine forest. I'll use this information to develop models that predict whitebark pine regeneration on the landscape. I have also established permanent monitoring plots in previously logged areas on sites similar to the unharvested stands. This initial assessment of whitebark pine recruitment success following harvesting and site preparation will be compared to the unharvested stand models. I also established a study site in one watershed to monitor before-and-after effects of several partial harvest treatments currently underway.

I collected information on the level of blister rust infection and mortality at each site. To date I have visited 15 sites, all of which were infected by blister rust. The average incidence of infection (active and inactive cankers) on live trees of any size was 45 percent. The average stand mortality that could be unambiguously linked to blister rust was 11 percent. These infection and mortality levels are 40 percent less than those reported by Smith et al. (this issue) for the Waterton Lakes area, due east, along the continental divide, but just slightly greater than levels reported by Zelgen (2002) for this same forest district.

An interesting feature of my data was the striking amount of variance between nearby sites. The range of incidence of live tree infection was between 7 and 89 percent, and the range for stand mortality caused by blister rust was between 0 and 38 percent. Campbell and Antos (2000) showed a similar range of stand infection in their southeastern BC study area near Cranbrook. In their models (which included more data from across the province), the incidence of rust was

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Whitebark pine blister rust surveys: Glacier National Park to Jasper National Park

Cyndi Smith[1], Tara Carolin[2], Sal Rasheed[1], Rob Walker[1], Brenda Dobson[1], Brendan Wilson[3] [1] Parks Canada Agency, [2] US National Park Service, [3] Selkirk College

In 2003, Waterton Lakes and Glacier national parks, in partnership with the WPEF, received a Y2Y-Wilburforce Foundation grant (see the Spring/Summer 2003 issue of *Nutcracker Notes*) to assess the health of whitebark pine in the study area. Our objectives were to determine the population trend, levels of white pine blister rust infection, and restoration priorities and opportunities. We tested the methodology for monitoring whitebark pine for blister rust infection that was developed by a multi-disciplinary committee of the WPEF (Tomback et al. 2004).

A total of 110 whitebark pine plots were surveyed for blister rust in 2003, between Glacier National Park (GNP), Montana and McBride, British Columbia. We examined 6,500 trees and 2,834 saplings (>1.3 m tall). Eighty-seven percent of the plots contained active (sporulating) cankers, and 95 percent of the plots were infected, counting active and inactive cankers. Nearly 11 percent of the saplings greater than 50 cm tall were infected, a higher infection level than the smallest saplings perhaps because they are older and provide a larger target for spores.

Eight of the plots in Waterton Lakes National Park (WLNP) were re-surveys of plots established in 1996 by Kate Kendall (unpubl. data). An average of 60 percent of the trees per plot were dead. Forty percent of the live trees contained sporulating cankers and an additional 25 percent of the trees appeared to have inactive cankers, for an average infection level of 65 percent. The average infection level (active and inactive cankers) of all seedlings was 28 percent.

The increase in percent mortality from all causes (60 percent in 2003 vs. 26 percent in 1996) was statistically significant, but the increase in the percent of live trees that were infected was not significant. There was a 4.8 percent increase in the mortality per year between 1996 and 2003, and a 2.6 percent increase in infection level per year. This mortality rate is higher than the mortality rate over 20 years (2 percent per year) estimated by Keane and Arno (1993) in Montana. While the sample size is small (eight plots) these trends are of significant concern. In WLNP there has been insignificant mountain pine beetle mortality since the early 1980s, so this increased mortality may be attributed to blister rust.

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Reading Between the Lines: Tree-Ring Analysis of a Whitebark Pine Stand

Dr. Lori D. Daniels, Dendroecologist and Biogeographer
University of British Columbia, Vancouver, B.C.

Dendroecologists use *crossdating* to examine patterns of tree rings in order to address ecological questions. Crossdating allows us to identify *false rings,* bands of cells that look like an annual ring but actually are formed mid-summer when trees are stressed, perhaps due to drought. This technique also detects *missing rings*—years in which trees are so stressed that they are unable to form an annual ring. By aligning ring-width patterns between live and dead trees, dendroecologists can date rings in trees that died long ago. By crossdating ring-width patterns between trees from different locations, we can interpret how climate, fire, insects and pathogens have affected the forest.

The North American DendroEcological Fieldweek (NADEF) is an annual field course that teaches these methods. In July 2003, NADEF was held at the University of Montana's Lubrecht Experimental Forest. Seven participants formed a research team dubbed the "Ridgetop Ghostbusters." Cathy Stewart, Fire Ecologist for Lolo National Forest assigned us the task of deciphering the mystery of the "ghost forest" of weathered whitebark pine snags atop Morrell Mountain near Seeley Lake.

To describe the forest structure, we tallied all seedlings, saplings and trees in three large plots. We recorded a preponderance of subalpine fir over whitebark pine, especially among smaller and younger trees. The largest, living whitebark pine was 48 cm (19 inches) in diameter and the largest, living subalpine fir was only 22 cm (9 inches). The size distributions suggested that the subalpine fir were younger than the pines and the fir population was increasing, while the pine population appeared to be decreasing. By increment boring sample trees we found that dominant whitebark pines ranged up to 567 years of age and had become established between 1436 and 1620. Tree growth on this exposed, high subalpine site was very slow. Diameter growth averaged about 55 rings per radial inch!

Historical records show there was a mountain pine beetle outbreak at Morrell Mountain in the late 1930s. We hypothesized that the old, weathered snags might have died in the 1930s and snags with bark still present had died more recently. However, crossdating of the ring-width

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How Blister Rust Spreads

Brian W. Geils
USDA Forest Service, Rocky Mountain Research Station, Flagstaff, AZ

We've read about losses of western white pine and sugar pine from blister rust, and we are now seeing what the rust can do as well to high-elevation pines such as whitebark pine. We know blister rust was introduced to western North America about a hundred years ago. There was early hope, the rust would be held back to the cool, wet forests of the Pacific Northwest and Northern and Canadian Rockies. The rust couldn't do well in cold high-elevation forests or warm, dry forests of the southern Sierra and interior West. But it did. Not only by progressive expansion of infested areas, but also by leaps did the rust spread eastward and southward until it is now even in New Mexico. So where is blister rust going next? Will it fill in the gaps? Will it reach the cloud forests of Mexico? If an Asian blister rust that infects from pine to pine were imported on a bonsai white pine, where might it spread to?

The history of blister rust spread is illustrated in the recent publication, "Managing for Health White Pine Ecosystems in the United States to Reduce the Impacts of White Pine Blister Rust" (www.fs.fed.us/foresthealth/pubsindex.shtml). In the last few decades, white pine blister rust appeared as isolated infestations in the Black Hill (SD), in the Sacramento Mountains (NM), the Jarbidge Mountains (NV), and the Sangre de Cristo and Wet Mountains (CO). In contrast to these long leaps, the rust after long residence in the local area has spread only a few miles south in southeastern Idaho and a few tens of miles south into northern Colorado. In New Mexico, however, the rust appeared shortly after its Sacramento Mountains discovery in the nearby but still isolated ranges of the Capitans and Gallinas. Although several Clark's nutcrackers have recently found their way to the Davis Mountains (TX), blister rust could not be found in the white pine there (in 2003). Neither has it been found in other ranges of Nevada (except possibly the Ruby Range), Utah, or Arizona (and not for lack of searching!).

Based on his experience with the annual, long-distance spread of peanut rust into Texas, Van Arsdel and others speculated in 1998 that the origin of the blister rust New Mexico may have been California. Richard Hamlin and others (2000, *Phytopathology*) demonstrated that the rust collected in New Mexico had narrow genetic variability (suggesting a single introduction) and similarity to other western populations (discrediting any notion the rust was brought in from eastern North

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Monitoring Blister Rust in the Central Rocky Mountains

Jim Hoffman, John Guyon, Kelly Sullivan,
Jeri Lyn Harris, and Eric Smith
USDA Forest Service, Forest Health Protection Staff,
located (respectively) at
Boise, ID; Ogden, UT; Lakewood, CO; Lakewood, CO;
and Fort Collins, CO

In 1990 white pine blister rust (*Cronartium ribicola)* was found on southwestern white pine in southern New Mexico, more than 600-miles from any known populations of the introduced disease of white pines. Several theories were proposed to explain the discovery: 1) there could have been an accidental introduction of the fungus to the Southwest on infected nursery stock from Idaho; 2) a rare meteorological event conceivably could have transported the fungus from central-California to New Mexico; or, 3) the disease migrated naturally via the widely dispersed populations of five-needle pines in the Intermountain and central Rocky Mountains Regions.

Investigations of the first two hypotheses were really contingent upon first disproving the theory of a bridge of infected pines connecting the New Mexico outbreak to older areas of infection in the northern Rockies. So in 1995, a formalized, large-scale white pine blister rust survey began in the Intermountain Region by J.J. Smith, (currently at Northern Arizona University in Flagstaff, AZ) and Hoffman. Direction for the survey methodology focused on whitebark pine, as it is the primary white pine species in southern Idaho and western Wyoming. Fortunately, Kate Kendall, Diana Tomback, and Bob Keane were available to provide encouragement and advice.

The survey, conducted over three summers, discovered blister rust intensification in most of the same areas where the disease was noted and reported from in the 1960's. On the positive side, however, there was limited spread of the disease into uninfected areas. A notable exception was the first report of white pine blister rust in Nevada, on whitebark pine east of Lake Tahoe.

Forest Health Protection plant pathologists from the Intermountain (Hoffman and John Guyon) and Rocky Mountain Regions (Dave Johnson, Jeri Lyn Harris, and Kelly Sullivan, in cooperation with Colorado State University scientists Bill Jacobi and Holly Kearns, surveyed over 600 white pine stands from 1995 up through 2003. Their efforts found blister rust disease for the first time in Colorado on limber pine in 1998.

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"Monitoring Whitebark Pine for Blister Rust"— WPEF's Workshop Filled Up

Diana F. Tomback

The Whitebark Pine Ecosystem Foundation workshop, "Monitoring Whitebark Pine for Blister Rust," June 28-30, 2004, at the Holiday Inn in West Yellowstone, promises to be a landmark event with respect to white pine blister rust management in the West. The instructors for both lecture and field portions of the workshop, who have all generously donated their time, represent the top experts on various aspects of the blister rust problem, including two pioneers in the field—Ray Hoff and Gene Van Arsdel. We are particularly grateful to the following agencies for providing funding for organization of the workshop and deferment of some of the expenses: National Park Service, Rocky Mountain Cooperative Ecosystems Study Unit (RM-CESU); Greater Yellowstone Coordinating Committee; Fire Sciences Laboratory of the USDA Forest Service, Rocky Mountain Research Station; USDA Forest Service, Region I, Forest Health Protection; and the University of Montana Continuing Education. This support has enabled us to keep the registration costs down.

The workshop runs from Monday evening, June 28 through Wednesday, June 30. Participants are also invited to attend the Whitebark Pine Subcommittee meeting of the Greater Yellowstone Coordinating Committee on Thursday, July 1 at the Holiday Inn. Registration for the workshop will be available by late afternoon on Monday, June 28 at the hotel, followed by a social with no-host bar at 6:30 pm. At 7:45, I will present the talk, "Vanishing forests: blister rust and the decline of white pine ecosystems," which provides a broad overview of the current impacts of white pine blister rust on our western forests.

Registration will again be possible before the indoor workshop program on Tuesday morning, June 29. The morning session begins at 8 am and includes the following topics:

- How monitoring should be used in conjunction with restoration—Ward McCaughey and Bob Keane
- Blister rust in whitebark pine: recognizing symptoms—Ray Hoff and John Schwandt
- Whitebark pine rust resistance screening at Coeur d' Alene Nursery—Dave Foushee
- Distribution of white pines of the West and implications for blister rust disease management in whitebark pine—Jim Hoffman

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Progress on the Whitebark Pine Genetic Restoration Program

Mary Frances Mahalovich
Geneticist for the USDA Forest Service's Northern, Rocky Mountain, Southwestern, and Intermountain Regions

Editor's Note: This is a follow up on the status of a project reported in Nutcracker Notes No. 2 (2002).

Last year was an exceptionally good year for cone collections throughout most of whitebark pine's distribution. It was a good year though for the Humboldt-Toiyabe National Forest (NF), as they completed identification of their remaining plus trees. Cone collections were made on 249 plus trees in Idaho, Montana, and western Wyoming. About 1.6 million seeds were collected in 2003 for future rust screening and gene conservation. A little over 78,000 seeds were collected on the Idaho Panhandle and Bridger-Teton NFs for restoration needs. Cone collection seasons 2001 and 2003 have both been outstanding cone years. Last year I was able to visit some of the plus trees on the Bridger-Teton, Custer, and Idaho Panhandle NFs.

Field season 2004 is expected to yield a moderate cone crop based on first-year conelet surveys and some phenomenal pollen crops in 2003. Cone collections will continue this field season, in part, due to funding made available by the Forest Service's Northern Region Native Plants Program.

The genetic restoration project has been ongoing since 2001 and participating units are reminded to be vigilant with the remaining cone collections. Long-term storage and seed viability remains unknown in whitebark pine. Installing wire cages is essential to protect the developing cone crop from Clark's nutcracker. Field units that rely on opportunistic cone collections without caging have once again come away empty handed.

Blister rust screenings in conjunction with the Forest Service's Dorena Genetic Resource Center are ongoing. Forests in the Northern Region collected 21 grams of aeciospores last year for use at Coeur d'Alene Nursery. One collection per Forest is planned for 2004.

Once there is enough seed from each zone, the seedlings will be challenged with blister rust to evaluate and utilize any resistance found in the original parent (plus) trees. Up until 2003, the Central Montana seed zone (CLMT) was in the

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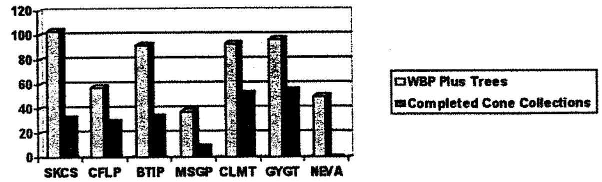
lead for the highest number of completed cone collections. The Greater Yellowstone/Grand Teton seed zone (GYGT) edged ahead in 2003, with 55 completed cone collections to CLMT's 52 (chart below). Some units have already had to select replacement plus trees due to losses from fire and mountain pine beetle.



Back in 2001 I wrote that we all know how difficult it is to access remote cone-bearing trees and to protect the developing cone crop from Clark's nutcrackers. Following a 10-year seed procurement planning exercise in 2002, three of the six seed zones in the Northern Region supported the development of one, one-acre orchard per zone. The top priority seed zones are the Bitterroots/Idaho Plateau (BTIP), CLMT and the Selkirk/Cabinet (SKCS). Rootstock was sown last spring and will be available for grafting in the spring of 2005 using scion from phenotypically superior plus trees.

The ongoing blister rust screening trial of 110 seed sources at the Coeur d'Alene Nursery will receive their fourth and final evaluation later this fall. Survivors from this screening will be planted at Lone Mountain Tree Improvement Area Idaho Panhandle NFs, in a field test to continue to monitor their growth and development and to serve as a clone bank. I anticipate completing the analyses of the rust data later this winter.

Another positive outcome of this project is increasing the awareness and need for protecting our other five needle pines at risk due to advancing blister rust. Many areas that support whitebark pine also have limber pine nearby. For more information contact the author at the USDA Forest Service's, Forestry Sciences Lab, Moscow, ID; phone (208) 883-2350, fax (208) 883-2318, e-mail mmahalovich@fs.fed.us ■

Conservation continued from page 6 ....

best related to stand age, or canopy cover, the presence of the alternate host in the stand (*Ribes* spp.), and the length of time without frost. In my data, these relationships were less clear.

Future work will focus on strengthening the data on stand structure and regeneration following harvest to assist in the development of robust guidelines for harvest prescriptions that aid in conserving whitebark pine.

Support for this project came from Global Forest Science and Parks Canada.

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Zeglen, S. 2002. Whitebark pine and white pine blister rust in British Columbia, Canada. Canadian Journal of Forest Research. **32:** 1264-1274.

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In 2004 more plots will be re-assessed in GNP, and more new plots will be established in the northern part of the study area. The high mortality and infection levels in the southern part of the study area suggests it should be of high priority for restoration activities. Only four plots in GNP and one in WLNP were identified as containing potentially rust resistant candidate trees (healthy trees in plots with ≥ 90 percent blister rust infection), which has huge implications for restoration efforts as there are virtually no seed trees available for natural regeneration. Not only is the connectivity of these high-elevation ecosystems threatened, but the very persistence of whitebark pine itself on the landscape is in doubt. The biodiversity that depends on whitebark pine communities is threatened by the loss of this keystone species.

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samples from snags indicated they died between 1776 and 2002. Overall, the ghost snags and many recent snags had been dead longer than we anticipated. Evidently, snags of whitebark pine decay very slowly.

We also compared growth rates to detect effects of blister rust on whitebark pine. Crown dieback is one sign of blister rust infection. We categorized the whitebark pines as "declining" (red needles, crown dieback) versus "healthy" (green needles, full crowns) and compared their ring widths. We expected the "declining" trees to have slower growth rates than healthy trees during the 20th century, but were surprised to learn there was no discernable difference in growth between "healthy" and "declining" trees over the last 200 years. Both groups of trees were growing slowly, perhaps due to interactions between blister rust and mountain pine beetle. We found blue-stain fungus—an indicator of infection by mountain pine beetles—in the cores of 4 of 5 "declining" trees and 7 of 12 apparently "healthy" trees. When we inspected the cores from recent and old whitebark pine snags, we discovered blue stain fungus in all cores. These results raise concern about widespread interactions between blister rust and mountain pine beetle and warrants further investigation.

Because the subalpine firs are small, we had assumed they became established following fire suppression in the 1930s. However, subalpine fir trees ranged from 86 to 307 years of age although diameters were only 5-25 cm (2-10 inches). Clearly, size is a poor predictor of age for subalpine fir! Moreover, given their well-documented susceptibility to fire, we concluded the last fire of any consequence at the study site occurred more than 200 years ago.

This brief study demonstrated that dendroecological research can provide useful information about disturbance regimes and interactions among disturbance agents that is needed to establish restoration goals in whitebark pine habitats. Our results did not support all aspects of general models of disturbance and succession in whitebark pine forests. They have raised some new questions about mountain pine beetle – blister rust interactions, fire history, and succession at high elevation sites.

The full research report is available on-line (www.geog.ubc.ca/~daniels) or by request (daniels@geog.ubc.ca).

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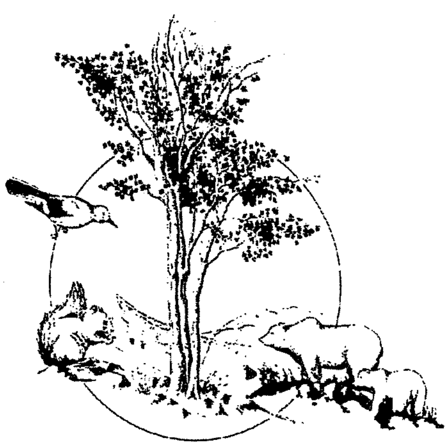
We are also urging workshop participants to contribute survey data to the whitebark pine and limber pine computerized rangewide database initiative begun by Blakey Lockman and Gregg DeNitto of Forest Health Protection, USDA Forest Service, Region I (blockman@fs.fed.us).

Two other initiatives came from our February board meeting: We are exploring an educational initiative that includes curriculum enhancements for grades K-12 as well as adults, centering on the ecology of whitebark pine. [Anyone interested in helping to develop this effort is urged to get in touch with Steve Arno (406 273 6271).] Secondly, we are hoping to generate funds to support several whitebark pine restoration projects in summer, 2005. We already have a generous offer of some funding from the Albert and Tricia Nichols Foundation. I also must mention that we are always looking for members who wish to participate actively in the WPEF. (Make yourself known to any board member, please!) Lastly, the board is excited about our September, 2004, annual meeting location—Waterton Lakes National Park, Canada—generously hosted by Cyndi Smith of Parks Canada [see back cover of this issue]. Late September should be an extraordinarily beautiful time to be in the Park, and I would love to see as many of our members as possible at the meeting. Without our members, we cannot do what we are doing. ■



Forest Plan Revision Continued from Page 5 . . . .

ning team questions, such as: What is the long-term viability of whitebark pine on this Forest? How is it currently being managed? And, what measures have been initiated to restore and maintain its historical abundance?

You may want to raise the issue of serious threats to whitebark pine's prosperity in the high mountain ecosystem, where it is a keystone species critical for wildlife habitat and food, watershed protection, and esthetics. You might recommend measures the Forest Service could take for the species as part of their management responsibilities. Also, planners need to know that restoration procedures have already been developed for the species and have been conducted in several locations.

The following forests are currently undergoing Forest plan revisions and are grouped according to planning zones. Zone leaders, indicated below, are the best source of information on dates and methods for submitting recommendations or asking questions.

Beaverhead-Deerlodge NF zone:
Marty Gardner 406-683-3860
Kootenai and Idaho Panhandle NF zone:
Kirsten Kaiser 406-283-7774 and
Gary Ford 208-765-7478
Flathead, Lolo, and Bitterroot NF zone:
Lee Kramer 406-329-3848
Clearwater and Nez Perce NF zone:
Ihor Mereszcak 208-935-4270

In addition, the Custer/Gallatin NFs and the Helena/Lewis and Clark NFs will start their revision process in 2006. All of these forests contain whitebark pine communities and would be valuable sites for whitebark pine restoration. Look up your local Forest today and become involved! ■

Blister Rust Spreads Continued from Page 7 . . .

America). Later (unpublished) work by Hamlin gave greater weight for a California origin rather than elsewhere in western North America. The oldest cankers found in New Mexico dated rust establishment to about 1970.

Of the five spore stages involved in blister rust reproduction and spread, the spring stage produced from cankers on pine and infecting currants and gooseberries is the best candidate for long distance transport. But even that stage has a short period of viability and other requirements to germinate and infect a host. Could a time be found when atmospheric conditions were favorable for upper air transport of rust spores from California to New Mexico and favorable for infection? How often do such conditions occur?

With support and consultation from the USDA Forest Service (Forest Health Protection and Rocky Mountain Research Station), Katrina Frank examined the meteorological factors for blister rust spread. Katrina completed her dissertation at the University of Delaware under Laurence Kalkstein. We applied epidemiological criteria for rust development to a large NOAA data set of meteorological variables for North America describing the period from 1965 to 1974.

Using several mathematical techniques, Katrina reduced millions of observations down to 16 patterns of high and low pressure systems over North America. Air flow at upper levels where spores could be transported in less than a couple of days can be determined from maps of these high and low pressure systems. The air flow for one pattern (Summer Trough) was very well positioned to transport spores from California to New Mexico. Two other patterns were good; one pattern was fair; and the other pattern unlikely for successful transport. We developed a "moving-window" index rank each 6-hour period over a spore-dispersal season (April to July) for each year of our data set. The index rank indicated how relatively favorable was a 6-hour period for successful transport considering criteria for both spatial connection and duration. Katrina also developed a way to identify and rank periods when surface conditions were favorable for infection (temperature, humidity, duration, and coincidence following transport). By so linking air flow maps and epidemiological criteria, Katrina was able to construct a set of calendars ranking each day for relative likelihood of rust introduction.

Only 33 times during the period from 1965 to 1974 were atmospheric conditions identified as very high for introduction. The most favorable extended period was the first two weeks of June, 1969 when conditions were very favorable for 66 hours when a stationary front stalled over New Mexico for an unusually long period in association with a series of (typical) transport events. The year of 1969 was also distinguished as particularly favorable for intensification of the rust during the summer and for spread to the perennial pine host in the late summer.

Building on our success characterizing the rust-introduction meteorology of the Sacramento Mountains, we are now investigating the same phenomena for other new infestations in the Jarbidge and Sangre de Cristo Mountains. These three cases provide a reference for ranking the likelihood of infestation in the Spring Mountains (southern NV), Zion (southwestern UT), and San Francisco Mountains (northern AZ). Early results suggest that conditions for transport alone are frequent (40 to 80 percent of the time), but these seldom coincide with conditions favorable for infection. Beside identifying detection and monitoring priorities, information of this sort can be useful to assess long-term potential, continued re-introduction and gene flow. ■

Workshop Filled Continued from Page 8 . . . .

- Mountain pine beetle in whitebark pine: life history, symptoms, and plus tree protection—Sandra Kegley
- The role of *Ribes* as alternate host and examples from Greater Yellowstone—Brian Geils and Maria Newcomb

The afternoon session focuses on sampling and database issues, and a step by step presentation of the sampling and monitoring methods developed by the WPEF:

- The new rangewide database for whitebark and limber pine—Blakey Lockman and Gregg DeNitto
- Establishing a sampling protocol: selecting areas for placing transects for surveys, long-term monitoring, and statistical analysis—Steve Cherry
- Establishing a sampling protocol: discussion led by Diana Tomback
- Step by step methods for survey and monitoring—Team presented
- Notes from the field: using these methods—Cyndi Smith
- Step by step walk through of the WPEF methods database software—Brent Frakes

The field instruction on Wednesday, June 30, consists of a morning session, where the basic tasks associated with setting up a survey plot and gathering data will be taught in a multi-station format. The afternoon session, where participants work in teams, involves setting up and actually sampling one or more plots. The session will end with the teams entering data in the data base and comparing summary statistics. ■

Monitoring Blister Rust Continued from Page 8 ...

More disturbing was the first report of white pine blister rust in a natural stand of bristlecone pine in 2003 in Great Sand Dunes National Monument, Colorado.

In 2004, John Guyon of the Forest Health Protection staff in Ogden, Utah will be surveying the mountain ranges in north-central Nevada and western Utah for blister rust disease on whitebark, bristlecone, and limber pines. Field reports from foresters in the area indicate a possible "wave-year" of infection that occurred in 2001 throughout the area. This is disconcerting because one bristlecone pine grove in Great Basin National Park in eastern Nevada contained a tree that was dated at 4,900 years old!

In Colorado, Kelly Sullivan will hopefully finalize one of the last missing pieces of the white pine blister rust linkage to New Mexico by surveying southward through the Sangre de Cristo Mountains in Colorado into Northern New Mexico. Future survey efforts point to southern Utah and Arizona, the last two western states in the continental United States to remain free of blister rust infection.

Several Forest Service Research projects are complementing the survey efforts. Katrina Frank and Brian Geils (Rocky Mountain Research Station, Flagstaff, AZ) are studying weather related long-distance dispersal of white pine blister rust from central California to New Mexico. Anna Schoettle (Rocky Mountain Research Station, Fort Collins, CO) is working on the geographic variation in resistance to white pine blister rust in Rocky Mountain bristlecone pine. At the Institute of Forest Genetics in Placerville, CA, Det Vogler has developed techniques for genetic identification of various *Cronartium* species, including *Cronartium ribicola* the causal organism of white pine blister rust. He is also trying to create a *Ribes sp.* genetics library. Gooseberries and currants are the alternate hosts for the blister rust disease.

Finally, in 2003 a national strategic plan was published that is entitled, "Managing for healthy white pine ecosystems in North America – a plan to reduce the impacts of white pine blister rust." The plan calls for using integrated genetics, pathological, silvicultural, and ecosystem management strategies to restore and sustain white pine ecosystems in the United States. (Website: www.fs.fed.us/foresthealth/pubsindex.shtml) ■

Whitebark Pine Fire Regimes in the Greater Yellowstone Ecosystem

Randy Walsh, Colorado State University,
Fort Collins, CO

Fire has been a dominant force in shaping forest communities for as long as vegetation and lightning have existed on earth. Knowledge of the historical fire regime in a given forest helps land managers determine whether recent wildfires are similar to those of the past and to evaluate changes in fire regime through time (Arno and Allison-Bunnell 2002). Perhaps current conditions are so anomalous in both a historical and ecological sense, that ecosystem sustainability is degraded (Swetnam et al. 1999).

Although investigators have found both stand-replacing and mixed severity fire regimes in many parts of whitebark pine's range, including sites within and adjacent to Yellowstone National Park, little data currently exists to quantify the historic fire regimes of whitebark pine in the Greater Yellowstone region. In 2003 I began a Master's project, under the direction of Dr. Bill Romme at Colorado State University, to investigate fire regimes and stand dynamics in whitebark pine communities. The study compares the physical structure (basal area, density, species composition) and stand-age structure of whitebark pine communities throughout the Greater Yellowstone Ecosystem (GYE). It also compares historical fire regimes among whitebark pine communities and evaluates the influence of surrounding forest types on fire severity and extent.

Research sites for this study are located on the high, forested, subalpine mountains in the Greater Yellowstone Ecosystem. These sites are dominated by whitebark pine, although subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and lodgepole pine (*Pinus contorta var. latifolia*) are co-dominants on many sites. A total of eight study sites will be sampled; three were completed in 2003.

Early Results and Observations

In sites sampled thus far, we have not found any evidence of a historic fire regime that has included a low-severity understory component. No trees in any of the three sites in the Beartooth or Absaroka Mountains have had multiple fire scars. Several whitebark pine exhibit single scars, but their origins can not be confirmed as fire-induced since basal scars are also caused by bole and root rots, mountain pine beetles, falling trees, and bears feeding on cambium. To

continued on page 16 . . .

New Database Tracks Status of Whitebark and Limber Pines

Blakey Lockman, Gregg DeNitto, Tony Courter, and Ronda Koski
[Lockman and DeNitto are USDA F.S., Forest Health Protection, Missoula, MT;
Courter is a contractor with INTECS and Koski is at Colorado State Univ., both located in Fort Collins, CO]

Whitebark pine and limber pine are well distributed throughout western North America. The impacts of white pine blister rust and other damaging agents are also found Westwide. These are forest types that have relatively little research compared to other white pine forest types, and thus the dynamics and impacts of detrimental changes are less understood. Although surveys have been done locally, information has not been compiled for a range-wide look at these two species. It is important to determine the condition of these forest types so restoration efforts can be developed and focused properly. A prototype database was developed by Eric Smith (USFS) and Holly Kearns (Colorado State University) for limber pine in Wyoming and Colorado. This initial effort has been expanded into a broader database with a GIS component.

Database/Interface Development

The Whitebark and Limber Pine Level 1 database consists of a limited number of critical fields representing key plot data variables that can be queried and GIS-linked via a user-friendly interface (see Figure 1). A workshop was held in May 2003 to develop this list of critical fields required to make a database application which can be easily queried. The application connects to the underlying MS Access Database using Microsoft Jet Database Engine technology. The application inserts, modifies and deletes values in the database using industry standard Structured Query Language (SQL) statements.

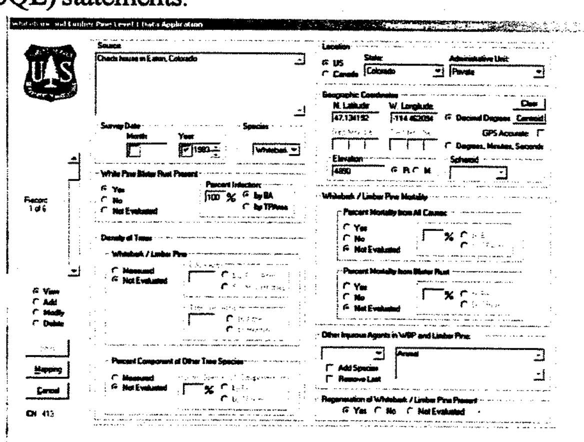


Figure 1.

The database interface is a robust application designed using Microsoft Visual Basic 6.0. Individual data fields are self-validating, assuring out of range values are not entered into the underlying Access database (see Figure 2). Specific data controls allow information to be entered using one of two common data units. For example, the Geographic Coordinates of the survey Plot can be entered using Decimal Degrees or Degrees, Minutes, and Seconds. Coordinates are automatically converted and saved as decimal degrees in the database (see Figure 3). Other Injurious Agents in Whitebark / Limber Pine are entered as list items in a comma delimited text field for ease of query (see Figure 4).

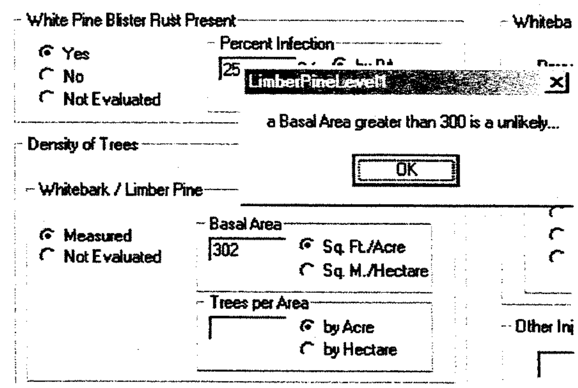


Figure 2.

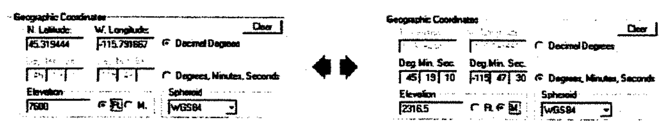


Figure 3.

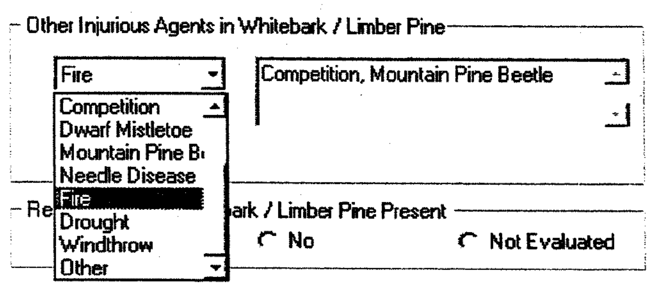


Figure 4.

A second level of the database includes the more detailed list of variables collected on each plot. The user can access available data for these variables, which will be queriable as yes/no statements. An example of such a variable is "*Ribes* evaluated, yes/no?"

GIS/Mapping Component

USFS FIA plot data are being used to map the distribution of whitebark and limber pine. Data from FIA Interior

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West Region are presently incorporated, and data from FIA Pacific Northwest Region and possibly FIA North Central Region, will be incorporated soon. Plans are in place to incorporate FIA plot data on the condition of the species into the database as well.

A data mapping function gives the application limited GIS functionality allowing survey plots from the database to be represented geographically over top of FIA data points and reference features like State and/or County Boundaries. The user can use the mapping interface to capture/edit coordinates for new or existing survey plots. Survey plots may be selected and their data displayed/edited interactively (see Figure 5). All reference feature data, including FIA, may be labeled or viewed with the 'identify' tool.

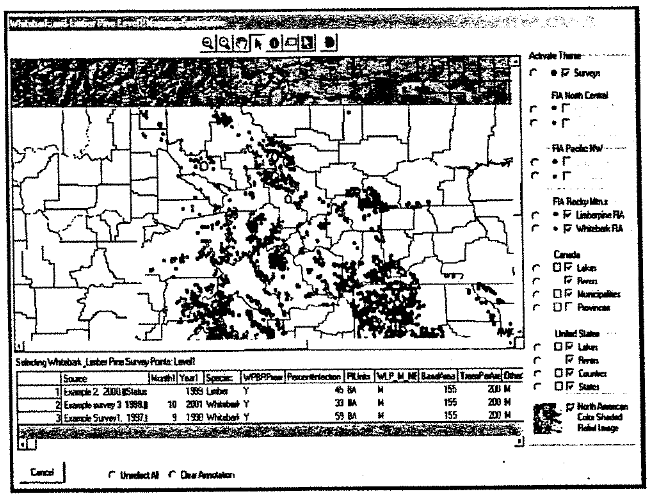

Figure 5.

This Mapping function is made possible by the inclusion of Map Objects Lite©, version 2.0 by Environmental Systems Research Institute (ESRI). These Active X program components allow the application to be distributed royalty free to any PC while providing many of the GIS functions found in ESRI products like ArcView©, ArcInfo© and ArcGIS©.

Summary

This effort will result in an interactive database, plus maps of the species distribution, the known locations of blister rust, the overall condition of the species, and a map that depicts the obvious data gaps on the condition of these two species. This database application will fit on a CD that can be distributed to interested parties, who can then enter new records into the database clones on their own systems. Newly entered data can then be exported and sent to a "yet to be identified" data repository for evaluation and potential upload into the main tables. The goal is for this database to be web-accessed. ■

An Interview with Cyndi Smith: WPEF's Canadian Representative

Editor's Note: Cyndi Smith is Conservation Biologist employed by Parks Canada. She is a member of WPEF's Board of Directors and is hosting the Annual Meeting and Field Tour in September at Waterton Lakes National Park.

Editor: What made you aware of whitebark pine and its ecological importance?

C. Smith: In the early 1980s I encountered whitebark pine as a park naturalist leading hikes into the alpine meadows near Mount Edith Cavell in Jasper National Park. We would often watch and discuss Clarks nutcrackers foraging among the groves of whitebark pine. Later, I learned more about the relationship between whitebark pines and nutcrackers from Ron Lanner's book *Made for Each Other.* But it wasn't until I was studying for my interview for the conservation biologist job at Waterton Lakes National Park that I witnessed the tragic mortality of both whitebark and limber pines caused by blister rust.

Editor: So, when you got the job at Waterton, you explored possibilities for helping whitebark pine?

C. Smith: Yes, whitebark's decline had already been identified as a management concern, I think mostly because of Kate Kendall's surveys here in 1996. The high levels of infection and mortality she found really opened people's eyes to the severity of the situation here. I started studying the scientific information about whitebark pine, including the WPEF's state-of-knowledge book, *Whitebark Pine Communities: Ecology and Restoration.* I sought out Kate Kendall and Tara Carolin, whitebark pine experts in adjoining Glacier National Park, and made many contacts with other Canadian scientists who were also concerned about this keystone species. Parks Canada botanist Peter Achuff identified one of the big information gaps as being the rate of advancing rust infection and mortality. The oldest survey data we had was Kate's 1996 survey, so I proposed to re-measure her plots in 2003.

Editor: What future work are you planning in whitebark pine restoration?

C. Smith: In 1998 Parks Canada conducted its first whitebark pine restoration project in the form of the Helen

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Fire Regimes Continued from Page 13 . . .

ensure that scars sampled have a high likelihood of being caused by fire, we have developed a key to aid in the selection of scarred trees to sample during the 2004 field season. This key includes a checklist of scar features, such as size and shape of scar, presence/absence of bark on scar face, multiple scars, etc.

The most convincing fire scars were single scars on whitebark pine at the edges of stands, adjacent to subalpine meadows. Due to the fact that nearby trees within the stand did not show signs of scarring, these scars may be recording fires that occurred primarily in the meadow, rather than in the forest stand. Attempts will be made in the 2004 field season to verify if whitebark pine stands elsewhere in the GYE tend to record adjacent meadow fires without fire spreading throughout the whitebark pine communities of interest.

We hypothesized that whitebark pine communities surrounded by an extensive, continuous subalpine forest composed of spruce/fir and lodgepole pine are characterized by infrequent, high-intensity crown fires which control stand structure in both the whitebark pine community and the surrounding subalpine forest. Thus far, our sampling has been conducted in these types of extensive, subalpine forest. The lack of evidence for low-severity fires occurring in these sites tends to support our idea that infrequent, stand-replacing fires are the dominant fire type.

Our second hypothesis concerns whitebark pine communities located near more frequently burned Douglas-fir forests, shrublands, or grasslands. In these communities, we expect that the historical fire regime was dominated by burns of varying frequency and severity, often of small extent. Communities in this type of landscape context, such as in the Wind River Mountains of Wyoming, and the Centennial Mountains of Idaho will be sampled in the 2004 field season. Here, we may find evidence more characteristic of a mixed-severity fire regime.

Our data collected in 2003 indicate that in at least some locations in the GYE, whitebark pine communities found in a matrix of dense, subalpine forest have little evidence of mixed fire regimes, and that current stand structure may be the result of infrequent, stand replacing fire events coupled with subsequent nutcracker seed caching. Additional sampling in 2004 will examine a greater variety of landscape contexts in which whitebark

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pine occurs in the GYE, and may reveal additional variability in historical fire regimes in these communities.

Literature Cited

Arno, S. F., and S. Allison-Bunnell. 2002. Flames in Our Forest: Disaster or Renewal? Island Press, Washington, D.C.

Swetnam, T. W., C. D. Allen, and J. L. Betancourt. 1999. Applied Historical Ecology: using the past to manage for the future. Ecological Applications **9**:1189-1206.

Interview Continued from Page 15 . . .

Ridge prescribed fire at Banff. Randall Schwanke, our Fire and Vegetation Specialist identified another proposed burn at Summit Lake in Waterton, but conditions have never been quite right. After looking over some of Bob Keane's mechanical and burn treatments at his Beaver Ridge site, we started planning mechanical treatments at Summit Lake that would enlarge the opportunity for burning by creating some conifer slash. I'm also collaborating with biologists and management specialists from Canada's other mountain parks to plan broader scale restoration activities.

Editor: Are there any efforts in Canada to encourage provincial forest managers to get involved in whitebark pine restoration efforts?

C. Smith: Representatives from the British Columbia and Alberta governments attended the 2003 Calgary workshop on whitebark pine. Since then, Alberta has become active in assessing the status of blister rust in both whitebark and limber pine. The broader restoration initiative I mentioned will attempt to involve provincial governments. We're hoping to attract foresters from both provinces to the September meeting and field trip at Waterton, especially since Bob Keane will be discussing mechanical and fire treatments.

Editor: You mentioned possible listing of whitebark pine as a "sensitive" species in Canada. How would such a listing affect restoration efforts?

C. Smith: If whitebark were listed by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) it would serve three purposes: raise the profile of whitebark pine and the threats it faces, ensure that different agencies work together to address the problem, and potentially make funding available. Under SARA (the national Species At Risk Act), manipulation might still be undertaken if it can be shown to be in the best interest of the species. Alberta is also considering provincial status assessment of both whitebark and limber pine. Probably 90 percent of the range of limber pine in Canada lies within Alberta. ■

Status of Whitebark Pine in Washington

A new report by Robin Shoal and Carol Aubry presents results of a detailed survey on the condition and blister rust infection levels of whitebark pine on the Olympic, Mount Baker Snoqualmie, Okanogan, and Wenatchee national forests in Washington State. A total of 28 sites were included in the study and blister rust was observed in live trees on all sites. Rust was also found in 33 of the 35 transects measured. The authors conclude that the high incidence of blister rust in whitebark pine on these national forests is cause for immediate concern. The severity of infection and high mortality rate lead the authors to recommend action to conserve whitebark pine using appropriate restoration techniques. Readers can obtain an electronic (pdf) copy of the report by e-mailing (caubry@fs.fed.us)

Members Needed:

Demonstration of a strong membership base is necessary for many of the grants we apply for to conduct restoration work. You can help our mission of restoring whitebark pine ecosystems by joining or encouraging a colleague to join. Members who recruit new members are rewarded with a cap, from the upcoming blister rust workshop: "Whitebark Pine Restoration Foundation: Because Blister Rust Never Sleeps!"

To join please mail this coupon with a check to:

Whitebark Pine Ecosystem Foundation
PO Box 16775
Missoula, MT 59808

______ $25 basic annual membership
______ $75 supporting membership (receives a hard-cover copy of 440-page book, "Whitebark Pine Communities: Ecology and Restoration")
______ $15 student membership (include a copy of student registration card or transcript)
______ $150 institutional membership
______ $1000 life membership,

Name: ______________________________

Company/Agency ______________________________

Mailing address ______________________________

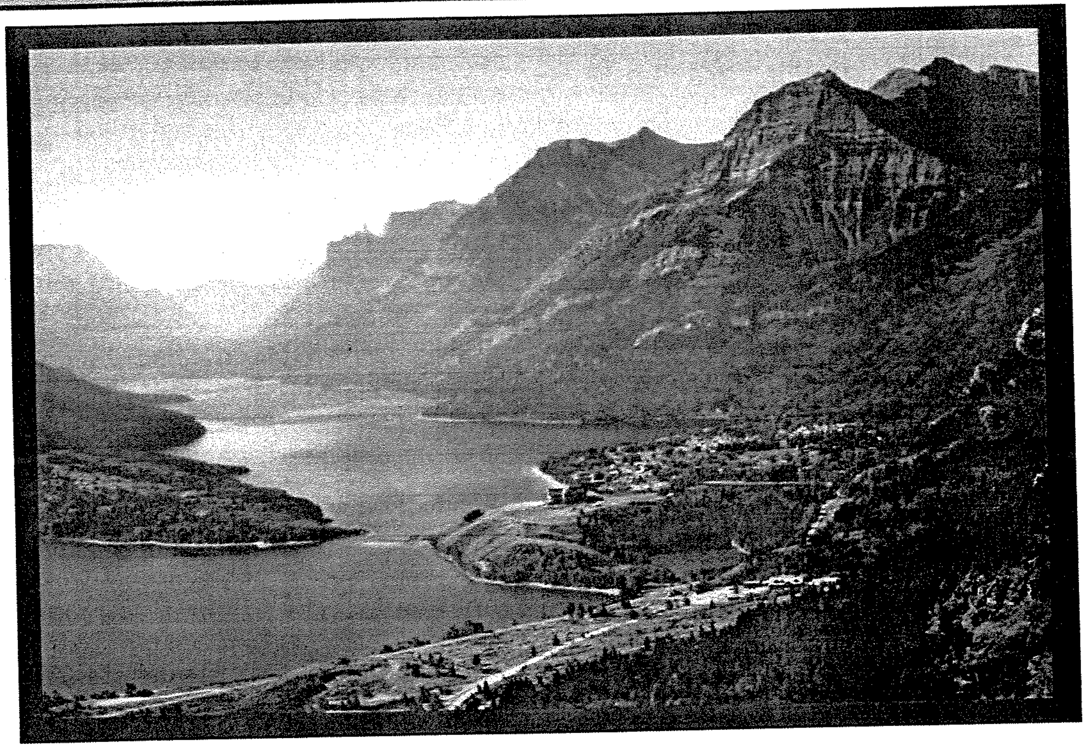
City, State ______________________ Zip ________

E-mail ______________________________

Phone ______________________________

Recruited by ______________________________

Waterton Lake National Park



Site of WPEF's Annual Meeting: September 24-26, 2004