Fall - Winter 2005

Nutcracker Notes

Whitebark Pine Ecosystem Foundation

Issue 9

Topics

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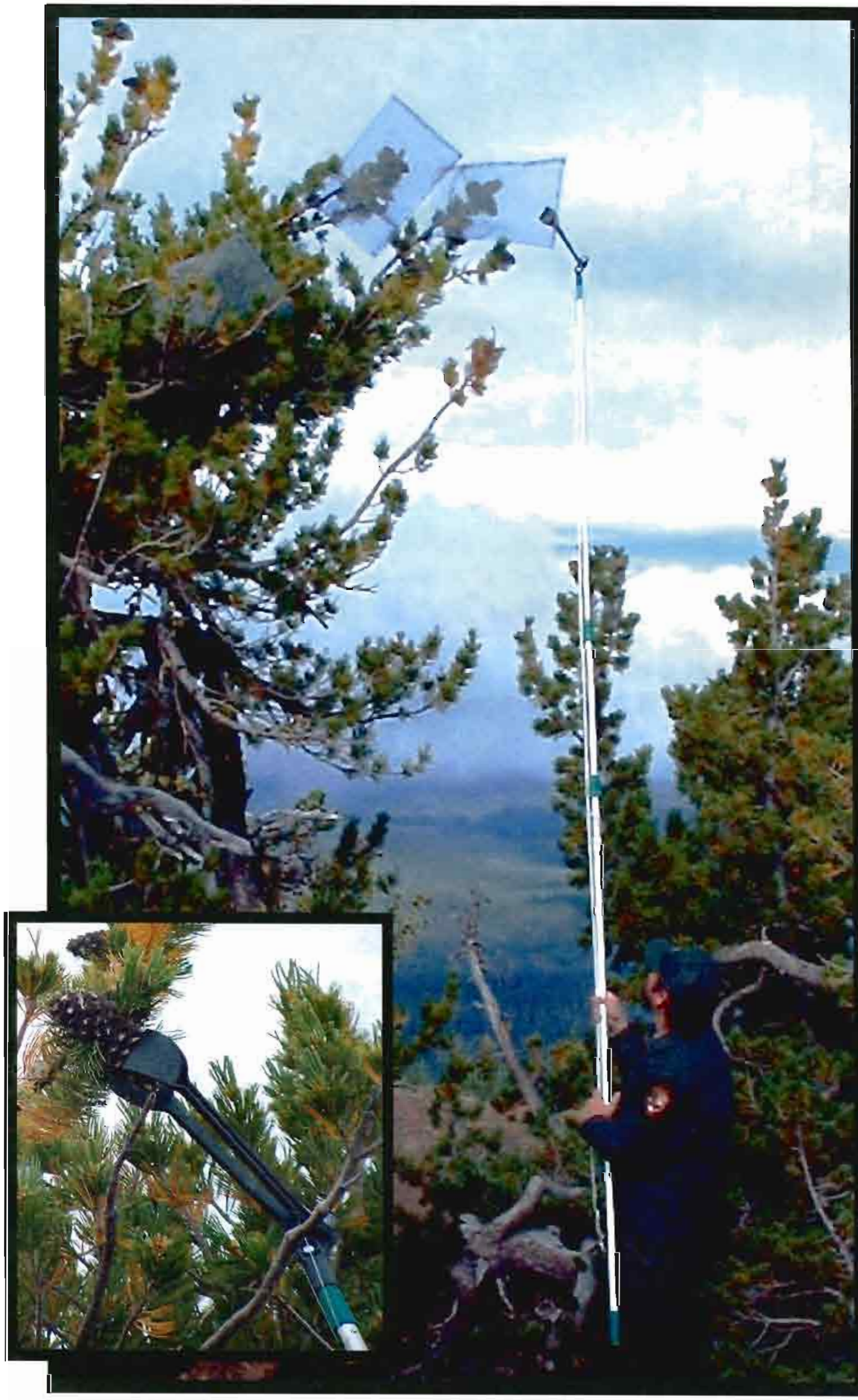

Tree Tong in use on Whitebark Pine. Michael Murray photo.

Whistler volenteers planting Whitebark pine seedlings.
Tapes mark out planting grid. Bob Brett photo.

Whitebark outdoor display sign that is available for purchase.
See article under "Announcements."

Director's Message

Diana F. Tomback

Pine beetles and whitebark pine management

In my last director's message, I voiced concerns for summer 2005: a potentially severe fire season and continued losses of whitebark pine and other five-needled white pines to mountain pine beetles (*Dendroctonus ponderosae*). Although the severe fire season did not arrive in most areas, the beetles certainly did. Extensive mortality of whitebark pine continues to occur throughout much of the U.S. range, from the Greater Yellowstone Area, to the northern Rocky Mountains, to the Pacific Coastal ranges. The loss of trees to pine beetles now complicates current and future restoration efforts, which depend on whitebark pine trees potentially resistant to blister rust.

Although mountain pine beetle upsurges are natural occurrences, they appear to correlate with periods of drought. In fact, a series of papers written by Jesse Logan and his colleagues from the USFS Rocky Mountain Research Station suggest that the recent outbreaks and northward movements of mountain pine beetles may result from global warming trends. Normally, temperatures in the whitebark pine zone are too cool to support beetles, which are endemic in lodgepole pine stands. They note that whitebark pine is a better host species than lodgepole pine, and that with rising temperatures, pine beetles are becoming endemic in whitebark pine, and now causing widespread mortality.

"...because Blister rust never sleeps"

Blister rust remains on the move. In 2004, the Greater Yellowstone Whitebark Pine Monitoring Group initiated blister rust monitoring by installing 45 permanent plots. The overall percent of infected whitebark pine trees was about 19%, as reported in the Spring-Summer 2005 issue by Dan Reinhart, who is with Yellowstone National Park and a member of the monitoring group (and board member of the WPEF). This information comprises critical baseline data for future monitoring.

Continued on page 4...

Previous assessments of different areas of the Greater Yellowstone Area, which were undertaken by several independent monitoring teams during a four year timeframe, offer an interesting comparison (see Table below). To some extent, the methods and criteria differed among all these assessments, but the criteria were unlikely to be greatly more conservative as compared to the earlier assessments. The average percent infection levels for these earlier assessments were lower than determined from the 2004 assessment, suggesting a general increase in blister rust infection

Researchers	Year	# plots	Location	Ave. % infection (range)
Kendall et al.	1996	75	Gallatin NF	2 (0-41)
Kendall et al.	1996	84	YNP, NW Wy	5 (0-50)
Kendall et al.	1996	32	Grand Teton NP, NW Wy	13 (0-54)
Harris	1999	14	Shoshone NF	12 (0-60)
Smith, Hoffman	2000	11	Bridger-Teton NF, NW Wy	10

Source: Table 11-1, K. C. Kendall and R. E. Keane. 2001. Whitebark pine decline: infection, mortality, and population trends. Pp. 221-242 in: Whitebark Pine Communities: Ecology and Restoration, D. F. Tomback, S. F. Arno, and R. E. Keane, Eds. Island Press, Washington, D. C

levels in the GYA. Some trees infected with blister rust will be dead within the decade, and others will suffer major canopy losses and reduction in cone production.

Annual meeting notes

Thanks to all of you who came from near and far to participate in a very successful annual meeting at Glacier National Park, September 11 and 12. We are particular grateful to Bryan Donner and Kate Kendall for organizing the meeting, and to Tara Carolin and Glacier National Park for hosting us. Although the hike to plant seedlings for restoration purposes was rained and snowed out, we ended up with a great impromptu science session on Sunday, with presentations and a lot of discussion. The formal Science session on Monday, September 22, was superb, with speakers from Northwest Connections, the Rocky Mountain Station, and a number of universities, including the University of British Columbia and University of Tennessee.

Intiatives and happenings

Thanks to a moderate cone crop this summer, cone collections for restoration purposes were undertaken in the Flathead National Forest, funded with the grant from WPEF's Restoration Initiative. We look forward to restoration work in 2006 on the Clearwater National Forest, which was also funded by the WPEF.

Two WPEF board members--myself and Bob Keane—and Dr. John Schwandt, USDA Forest Health Protection and Whitebark Pine Coordinator, together have submitted a proposal to the USDA Special Technology Development Program for funding to implement a large-scale experimental project to investigate the usefulness of direct seeding in whitebark pine restoration efforts. If funded, this three-year project will compare survival of whitebark pine seedlings grown in nurseries and outplanted, the current operational mode, against the survival of seedlings germinated from cached seeds. If direct seedling proves successful, it could greatly facilitate restoration efforts.

I am pleased to mention that the WPEF was invited to participate in the Ocotober 4 to 6, 2005, organizational meeting for the 2006 Pacific Coast Whitebark Pine Symposium. The organizational meeting and symposium are discussed in detail elsewhere in this issue. This meeting will be a major milestone in our collective efforts to bring the plight of whitebark pine to national attention, and it will showcase the status, ecology, and restoration of whitebark and other five-needled white pines in the Sierras, Cascades, and coastal ranges. My thanks to Susan Johnson, Sheila Martinson, and Ron Mastrogiuseppe for being the driving forces behind this organizational meeting, and to Michael Murray at Crater Lake National Park for hosting the meeting.

The WPEF has been mentioned in several articles as of late, in part because whitebark pine has been tied to the discussion concerning grizzly bear delisting. Two examples include: "Attacks on pines threaten grizzlies" by Theo Stein on the front page of The Sunday Denver Post, and "Key food for grizzlies is in deep trouble" by Brodie Farquhar of the Yellowstone Journal. Coinciding with the organizational meeting for the 2006 Pacific Coast symposium were several articles written by Lee Juillerat in the Klamath Falls Herald and News. These highlighted the outlook for the picturesque whitebark pines at Crater Lake National Park, which are threatened by both blister rust and mountain pine beetles, and the symposium planning workshop.

Housekeeping

Along with the issue of Nutcracker Notes you should find a copy of the proposed by-laws for the Whitebark Pine Ecosystems Foundation. Please read them and return your vote, so we may officially institute these. Also, I would like to remind you to check our website (www.whitebarkfound.org) for the summer, 2005 revision of the field methods Monitoring whitebark pine for blister rust" for a link to download the revised database by David Pillmore and Brent Frakes of the Rocky Mountain Network Inventory and Monitoring, National Park Service. Finally, our website is being substantially revised, which is being spearheaded by board member Dana Perkins, and volunteer Lisa McKinney and others, working with our webmaster Chuck Crouter. ■

Has your postal address or e-mail changed? If so, please notify

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Reflections of a 1950s Ribes Picker

Larry Wright

In 1952 as a recent high school graduate I left Pennsylvania for western Montana to work as a Ribes picker and help save the western white pine from the spreading plague of blister rust. Ribes is the genus of currant and gooseberry shrubs which are the alternative host that facilitates the spread of blister rust.

My older brother drove his friend and myself West in his 1947 Chevrolet. They were 18 years old and were able to work in Oregon near Prospect, but as a 17-year-old Oregon would not allow me to work there, so I was dropped off at the Haugan, Montana, camp (near Saint Regis) and about 7 miles off highway 10, twice fording a creek to reach the isolated camp. My brother was in a hurry to leave for their camp in Oregon so there were no long goodbyes. I was left with my duffle bag. The Camp Boss, Mr, Daniels, was a nice old forester who directed me to his assistant. I was then escorted to a four man tent that would be my home for the next three months. There were hundreds of these camps with thousands of young men working summers for the Forest Service. Our camp was laid out military style with two rows of tents and a road leading to the headquarters building, mess hall, and shower. Camp managers and assistants were billeted with two people per tent separated from the workers. All tents had wooden floors and a wood stove that was used almost daily to take the morning chill from the air. If the tent mates left wood ready for starting a fire, the camp's helper would arrive early to start a blaze and we would arise to a warm tent. The wood stove was also helpful in drying wet clothes and boots on rainy days.

The mess hall was in a wooden building where all 75 or so of us could eat in two shifts. The cooks were full time and kept us well fed. The shower area had four heads, so timing cooperation was important with the first to arrive getting the hottest water and the last to arrive getting lukewarm or cold water unless they put more wood on the fire and waited. The privy was a deluxe four holer up on a hill out of sight and smell. Though lots of lye and lime was used, it was not a place to linger.

The first days of work were spent learning about Ribes and the procedure for eradication. We were taught identification of the three Ribes in this area (R. viscosissimum, lacustre, and cereum), and shown how to use a hoedag for digging. If roots were left in the soil we were to paint the purple 2-4-D on all exposed root areas trying not get any of this poison on us. Each of us would carry a small bottle of this now regulated chemical. My small bottle lasted all summer. In areas where the ground was covered with masses of mostly R. lacustre, teams of two or three workers would spray 2-4-D on the entire crop.

We laid out a large grid and systematically cover all the ground. At the end of each day we totaled the Ribes plants dug and which lots within the grid we had finished. Checkers would then evaluate our work to see if any Ribes were missed. If so, the lot would have to re-done and rechecked. The hoedag was a handy tool, but the standard issue long handle was awkward. Often we were on our knees when digging and pulling, so most of us cut the handle down to about 24 inches making it much easier to swing with one hand.

The Forest Service issued a canteen and a small first-aid kit for our belts but no mosquito repellant or sun tan lotion. Our lunch bags were made from old cloth flour sacks we also tied to our belts with lunch foods we assembled after breakfast. Lunch was much the same each day; a sandwich, fruit, canned juice, etc. and cool water if we were near a spring. There was no need for water purifiers in the 1950s. After a 30-minute lunch break it was back to work until 5:00 PM. Our work week was Monday through Saturday. At the end of the day we hiked back to camp (unless we were trucked to a distant location) and a hot shower, if lucky, and then in line for supper. After supper it was free time to read or visit the camp dump-site to see if any bears would come to scavenge.

Each day I worked energetically trying to take the lead in production of Ribes removal, and after about month was one of two selected to be trained to string lot lines. We were trained to read the compass and to pace off chains (66 feet) in all types of terrain. Then, my job was to follow a compass heading and string a line up the mountain with a lot tag every five chains. I traded my hoedag for a string ball a compass, lot tags and pencil, and started preparing areas for the eradication crews. I enjoyed seeing how accurate my compass readings when checked against section markers. When enough lots were prepared for the summer, my work switched to checking, another enjoyable assignment.

Not all work at the camps was centered around Ribes eradication. Camp members were also trained to fight fires, but it wasn't until the next summer that I was assigned to fire duty. My income for this first summer was $850, a handsome sum for a 17-year-old and my first real money. I made it last until I returned the next summer. Tuition at Pennsylvania State College was $85 per semester, and my most expensive text book was $11.

Upon my return to blister rust work in I953 and 1954, I was stationed at Priest Lake, on the Kaniksu National Forest in the Idaho Panhandle. I worked as a checker because of prior experience and expertise in spotting Ribes. When fire activity increased I worked as a smoke chaser. Bearing coordinates were given after a lightning strike was spotted, and off I went, sometimes in the dark, with a compass and a shovel to throw dirt on the split smoldering tree so fire would not spread.

When not on fires, my blister rust work continued as a checker of the drag line crews and doing advanced survey work in remote areas to determine the amount of Ribes that might be scheduled for work crews. Two of us made up the Survey team. I ran the compass line and my teammate crisscrossed behind me counting Ribes. The total was then given to the management for determination of work. We camped out. Equipment was packed in on mules as we followed on foot to the camp site where we were to stay for two weeks while surveying. On these remote assignments we had a radio and a set time to call in each day reporting our progress.

Cooking was a shared job with ample variety. We hung our fresh meat and hams on the end of a rope high up on a tree limb to keep it away from the bears, but of course not free from flies. So meat would last only a few days before it spoiled and was covered with maggots. We took the spoiled meat far from camp so that the bears might enjoy a snack. After this camp out, it was back headquarters for our next assignment which took us by boat to the Upper Priest Lake area where we stayed in a Forest Service cabin. The cabin was right on the lake with its own dock that made a great diving platform for our evening swim. A few other private cabins were nearby, one of them was owned by a professor from Washington State College at Pullman. How lucky we were to use this cabin with its full kitchen, bathroom, bedrooms, and a fireplace in the main room.

My last experience working for blister rust control was helping fight a Forest Fire at Tin Cup Gulch out of Hamilton, Montana. The fire kept crowning and we were pulled back time and time again to start a new line. My assignment was the straw boss of the lead crew just behind the D9 dozer, keeping alert for trees as they were pushed over. One tree was dropped into the ground fire and while I was trying to remove it, I got too close to a swinging Pulaski and it hit my foot. This ruined a perfectly good pair of White caulked boots and resulted in amputation of two toes. The going rate for toes was $350 each and $500 if you lost a big toe. My earnings that summer came to $1250, so with the addition of the injury of $700 I was able to pay for the last two years of University expenses.

With thanks to this Forest Service Program, I look back at the blister rust work experience as a very wonderful time for a teenager. ■

Dendroecology Applications for Whitebark Pine Ecosystems

Saskia L. van de Gevel, Henri D. Grissino-Mayer, and Evan R. Larson
Laboratory of Tree-Ring Research, The University of Tennessee, Knoxville

We used dendroecological techniques and analyses to help provide high-quality, temporally precise information on the ecological status of threatened whitebark pine ecosystems in the Lolo National Forest (LNF) in western Montana. This research investigates the ecology of whitebark pine communities using stand dynamics and dendroecological methods to provide a long-term record of forest growth and development in diminishing whitebark pine communities in LNF. This project emphasizes the combined effects of stand dynamics, disturbance regimes, and climate-fire regime interactions in the northern Rocky Mountains. Knowledge of the complex stand dynamics and stand history of whitebark pine ecosystems is essential to the long-term management and restoration of this declining keystone species.

To better understand the dynamics of these declining communities, we investigated combined

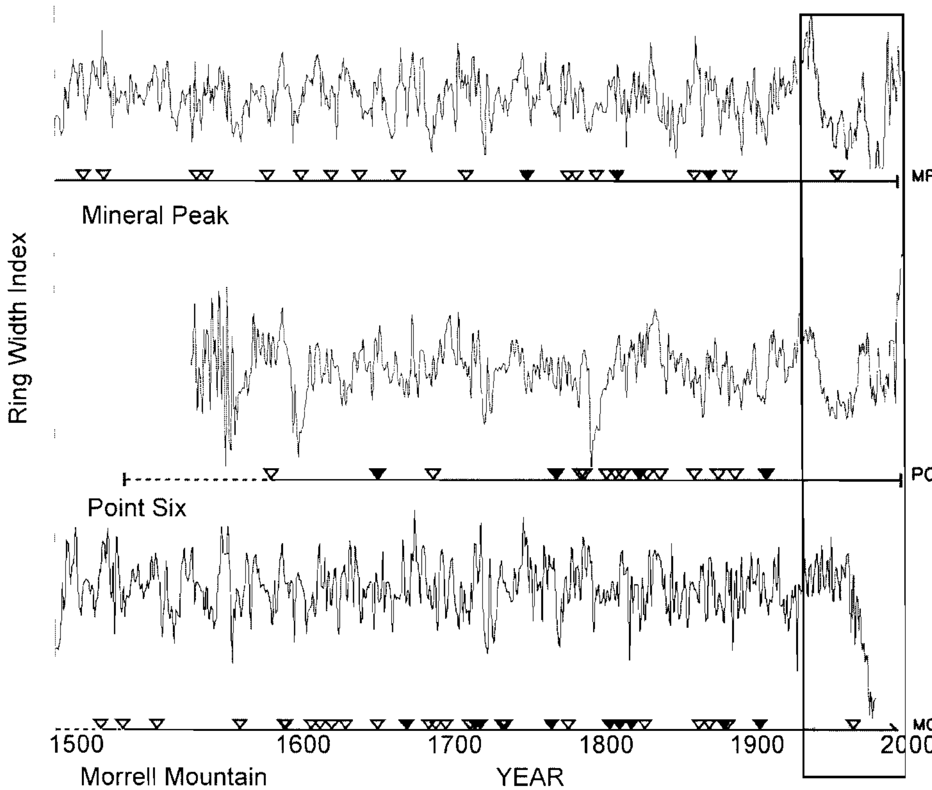

Figure 1. *Master whitebark pine tree-ring chronologies from three sites in the Lolo National Forest from 1500–2004. Horizontal dashed lines are the mean ring width index. The ring width index pattern above and below the mean indicates increases and decreases in growth over the past 500 years. The triangles along the composite*

fire chart lines show individual fire events at each site; black triangles indicate that a fire scarred 10% or more of the samples. The boxed area highlights the recent 50-year growth anomaly associated with the combined effects from white pine blister rust, mountain pine beetle outbreaks, fire suppression, and climate change found in our whitebark pine samples from 1950–2004.

effects of blister rust, fire exclusion, and mountain pine beetle, on the changing structure, composition, and vigor of whitebark pine communities. We found a strong decrease in tree growth from 1950–1980 in many of the whitebark pine samples (Fig. 1). This radial growth decrease may be attributed to white pine blister rust. Mineral Peak and Point Six samples recovered from a blister rust epidemic just before a landscape-level mountain pine beetle outbreak occurred in the 1980s. Several exogenous disturbances, including mountain pine beetle outbreaks, blue stain fungus, and blister rust are appearing in the tree-ring record, but more data are required to determine the regional impacts of these disturbance agents. We hope to investigate the decline in whitebark pine growth with the addition of sites in the Lolo National Forest, Beaverhead-Deerlodge National Forest, and the Flathead National Forest. We can determine if the growth decline from 1950–1980 was caused by white pine blister rust by comparing the last 50 years of growth with our subalpine fir chronologies, which do not exhibit this pattern. The unique 50-yr radial growth decline in our samples is the first whitebark pine study to record this growth anomaly in western North America. ■

Whitebark Restoration in the Mission Mountains Wilderness

Steve Lamar, Northwest Connections, Condon, MT

Northwest Connections, a nonprofit conservation/education organization, has been collaborating with the Flathead National Forest on a long-term restoration strategy for whitebark pine forests in the Mission Mountains Wilderness of northwest Montana. One of the primary goals of this effort is to support the Forest Service in changing the current fire management plan to accommodate prescribed restoration burns in this small, but important wilderness area.

Northwest Connections (NwC) is a citizen initiated conservation group in the Swan Valley that has initiated a number of ecological monitoring projects over the past ten years that aim to fill critical information gaps for ecosystem management and restoration. Tom Parker, one of NwC's founders, has long been passionate about the plight of whitebark pine forests throughout the northern Rockies. He first noticed the ecological significance of whitebark pine while guiding hunters in the western Bob Marshall Wilderness in the 1970's

John Ingebretson is the Swan Lake Ranger District's assistant fire management officer. He is also passionate about whitebark pine restoration and has initiated several small- scale projects to benefit the cause. But without funding to support work in the Mission Mountains, and with trepidations about the resistance that might come from the residents of Condon community, John and the Swan Lake Ranger District were not actively working on plans for whitebark pine restoration in the Mission Mountains Wilderness.

The National Forest Foundation's "Wilderness Stewardship Challenge Grant" program provided opportunity for field work and collaboration for whitebark pine restoration. With money provided through this program, and matched by donations from individuals supporting Northwest Connections, work began in the summer of 2005. Collectively, district staff and NwC staff agreed that the first step was to gather baseline data. So this field season consisted of mapping WBP stands within the wilderness area, and then following up with photo points and a health assessment of WBP conditions within the stands.

Up until the past few years, many of the WBP stands within the Mission Range had weathered the non-native white pine blister rust with less lethal results than the neighboring Swan Range. Unfortunately, the mountain pine beetles have now moved into many of these stands and are killing off the older mature survivors. On the positive side there are a number of younger aged trees that are relatively healthy and seem to be doing well. Also, 2005 was a good cone-producing year for the mature, surviving trees. The Clark's nutcrackers were present and busily taking advantage of the available seed.

An interesting observation was noted when we surveyed one younger WBP stand that dated to a 1950's era forest fire. From a distance the stand appeared vibrant, cone producing, and healthy looking. But upon closer inspection we found that a black bear had recently entered the stand and proceeded to completely strip the bark from around the lower trunk of many trees in order to eat the sweet cambium layer. The bear seemed to pick the most vigorous trees in parts of the stand to strip. Whereas we often see this type of feeding by black bear upon young western larch trees at low to mid elevations, this was the first time we had seen this kind of extensive feeding on whitebark pine trees.

We are still in the process of analyzing our data from the summer, but we feel that fire could and should be put back on the landscape. Presently all fire in the Missions is suppressed due to a number of factors, but mostly relating to wind patterns that flow from southwest to northeast. This prevailing wind pattern has the potential to bring fire out of the wilderness and across the Swan Valley where the communities of Condon and Salmon Prairie lie. We feel that the location of the 2003 Crazy Horse Fire along the eastern edge of the Missions has given the Forest Service a golden opportunity. Much of the black area from that fire would provide a safety net to protect the community downwind from prescribed restoration burns in the interior of the Mission Mountains Wilderness. There are several other areas that had historically vibrant stands of whitebark pine with physical barriers that would provide natural fire breaks which lend the areas to restoration efforts.

Although our funding was limited, the amount of work that we were able to accomplish this past summer was encouraging and we hope useful. As an organization that is truly concerned with maintaining the natural connections upon the landscape, we strive to support agencies and people who are engaged in these efforts. ■

Recent Trends in Nutcracker Occurrence

Shawn T. McKinney, University of Montana, Missoulashawn.mckinney@umontana.edu

Within the last two decades many researchers in the field of conservation biology have documented the loss of vertebrate seed dispersers and the cascade of community effects that follow. Plants that are dependent on a vertebrate for seed dispersal are often characterized with having unusually large seeds that cannot be dispersed by wind or insects. Therefore, when the vertebrate seed disperser - be it primate, bird, bat, or reptile - is lost from the community, regeneration in the dependent plant ceases and local populations wink out. Historically, the seeds of whitebark pine helped to sustain populations of Clark's nutcrackers who in turn dispersed whitebark's seeds thereby accounting for regeneration of the species. The white pine blister rust epidemic, mountain pine beetle outbreaks, and successionally-advanced forest conditions have all contributed to a decline in the cone-producing potential of whitebark forests in the U.S. Northern Rockies. It is logical to believe that there exists a threshold of seed availability that is needed to ensure nutcrackers remain in a region. If cone production drops below this threshold, will whitebark pine be the next example in a growing list of plant species to have suffered the loss of their mutualist seed disperser? If this occurs the burden of restoration will fall on the costly process of planting rust-resistant seedlings.

To determine if there is a relationship between whitebark pine forest conditions and Clark's nutcracker occurrence, we collected stand-level data on whitebark pine cone production, relative abundance, crown damage, health and mortality, and conducted nutcracker observation counts. In 2004, within the Northern Divide Ecosystem (NDE), we conducted research in ten stands and in 2005 revisited six of these stands. Also in 2005, we added six stands within the Greater Yellowstone Ecosystem (GYE) to serve as a comparison to less damaged forests. The research is ongoing and results are preliminary, but what we have (or have not) seen is troubling.

2004 was a low cone-producing year for whitebark pine and we recorded only one nutcracker in 105 observation hours within the ten study stands in the NDE. In 2005, cone production increased within the six stands we revisited from 2004. Within these stands the number of trees producing cones increased from 15 to 37 and the number of cones produced from 482 to 1,669. Likewise, observations of nutcrackers increased; we recorded a total of 48 nutcrackers in 77 hours of observation in 2005. Clearly there is a strong relationship between cone availability and nutcracker presence. This trend however is tempered by the caveat that in five of the six stands we failed to observe a nutcracker in late August when seed dispersal begins. Therefore, during a relatively good cone-producing year, when the total number of nutcrackers increased, seed dispersal was still rare.

Research in the GYE this past summer allowed us to compare our NDE results to whitebark forests that are in relatively much better condition. We gleaned two important findings from this. 1) As the amount of living whitebark pine (measured as basal area) increased, the average number of nutcrackers observed increased in a linear fashion. 2) During the seed dispersal observation period (last two weeks of August), the average number of nutcrackers in the GYE was 9.2 per hour compared to 1.5 per hour in the NDE. These preliminary results show that nutcrackers are more abundant where there is a greater amount of living whitebark pine (and consequently more cones), and are more likely to be found in late August when seed dispersal initiates.

Are nutcrackers leaving whitebark pine forests in the NDE in search of alternative, more abundant food sources; or leaving the region entirely and frequenting healthier whitebark forests such as those in the GYE? Only time will tell if the pattern seen from these two seasons of research are indicative of broad-scale regional trends. If these tentative results are an indication of nutcracker occurrence in the NDE, the implication to whitebark pine restoration is that the vast majority of regeneration will have to come from planting rust-resistant seedlings.

This research was supported by a Cooperative Conservation Initiative grant from the U.S Department of Interior and Glacier National Park, a National Park Service scholarship, and the U.S. Forest Service, Rocky Mountain Research Station, Missoula, MT. Thanks to Sean Sweeney and John Fothergill for excellent field assistance and Diana Tomback and Kate Kendall for first identifying and outlining the potential perils of losing nutcrackers. ■

Status of Mountain Pine Beetles in Whitebark Pine

Ken Gibson, USDA Forest Service, Forest Health Protection, Missoula, MT

Early efforts by Forest Service personnel to reduce mountain pine beetle-caused mortality were aimed largely at killing beetles. The Forest Service, organized in 1905, was faced with its first mountain pine beetle outbreak in Montana in 1909. Infested trees were peeled, piled and burned, treated with toxic chemicals, and an array of combinations of those treatments for more that 50 years. Finally realizing the futility in trying to kill enough beetles to matter, Forest Service entomologists and silviculturists began to consider stand conditions that experienced the highest amounts of beetle-killed trees.

By the 1970s, we recognized that lodgepole and ponderosa pine stands, especially susceptible to mountain pine beetle outbreaks shared similar characteristics—generally larger-diameter, older trees, in more densely stocked stands. That recognition led to thinning studies and ultimately management recommendations directed at altering susceptible stand conditions to reduce beetle-caused mortality to acceptable levels. Current recommendations include reducing stand stocking to levels promoting vigorous tree growth and creating more-open conditions that beetles find less desirable. We also recommend creating a mosaic of age, size, and species composition where feasible. These recommendations have proven successful in some host species of the mountain pine beetle. How practical they may be in whitebark pine stands remains to be seen.

Currently, mountain pine beetle populations are at outbreak status in many parts of the Northern Region. More than 700,000 acres of host stands are infested, to some extent. Most of those infested acres are in lodgepole pine stands; however, almost 110,000 of them are in whitebark pine. Most of those are in northern Idaho, west-central and southwestern Montana, and Yellowstone National Park. This is the highest level of mountain beetle-caused whitebark pine mortality ever recorded in our Region. A similar series of outbreaks were known to exist in the 1930s, when even warmer conditions existed than do today; but we have no records indicating the extent of those outbreaks. By most still-existing accounts, those outbreaks may have been as extensive, perhaps more so.

Ground-collected data, obtained for a few selected stands in Yellowstone National Park and the adjacent Gallatin National Forest in 2004, averaged almost 100 and 160 whitebark pines per acre killed within the past three years, respectively. We believe this extreme level of mortality has resulted from unusually warm winter and summer temperatures experienced over the past few years, and may be very similar to conditions that existed in the late 1930s.

We have much yet to learn relative to silvicultural manipulations of whitebark pine stands, including the use of prescribed fire, to reduce beetle-caused mortality. In the meantime, however; we have had good success in preventing attacks using preventive sprays of insecticides; and to a lesser, but still-valuable extent, using the anti-aggregation pheromone, verbenone. It will be important for us to preserve older, cone-bearing trees from mountain pine beetle attacks during these next few years when breeding programs are being developed to forestall the effects of the introduced pathogen, white pine blister rust. The combined efforts of entomologists, plant pathologists, silviculturists, and other resource specials will be required if we are to successfully protect, preserve, and restore critical, high-elevation stands of whitebark pine throughout its historic range. ■

Ectomycorrhizal Fungi and Whitebark Pine

Cathy L Cripps and Kate Mohatt, Plant Sciences and Plant Pathology Department, Montana State University, Bozeman, MT; CCripps@montana.edu

While numerous studies have addressed the effects of fungi detrimental to whitebark pine such as the tree pathogen Cronartium ribicola (whitebark pine blister rust) and seed/seedling pathogens (James & Burr 2000), none (to our knowledge) have examined the beneficial ectomycorrhizal fungi associated with tree roots (Eversman in Tomback & Kendall 2001) and with the eye of a mycologist. There are two reports that confirm ectomycorrhizal fungi exist on whitebark pine roots (Johnson & Kendall 1994, Perkins 2004) and we have also reported this finding (Mohatt & Cripps 2005; Cripps and Eddington 2005). Ectomycorrhizal fungi (primarily Basidiomycota and some Ascomycota) are crucial to the survival and sustainability of forest trees, including Pinus albicaulis. They are a source of nitrogen and/or phosphorus, and various species offer protection from pathogens, drought, heavy metals, and/or root grazers. In nature, all pines are obligate partners of these mutualistic root fungi and they host a particular subset of the potential 6,000 species of known ectomycorrhizal fungi.

There is a more refined host-fungus specificity among the pine groups and between species, and particularly between 2- and 5-needle pine (Bruns et al. 2002). Even more interesting, the five stone pine species scattered around the globe are known to host a similar set of bolete fungi including species uncommon/unknown on other hosts such as Suillus sibericus (Moser 2004). In addition, soil and other abiotic and biotic conditions can further restrict a mycorrhizal flora (Cripps 2003) and the pH, organic matter levels and moisture content of soils in whitebark pine forests are of particular interest here.

The first objective of our research is to discover the native species of ectomycorrhizal fungi that associate with whitebark pine and to examine the ecology of these associations. Typically in forest development a predicted succession of mycorrhizal fungi replace each other as trees grow older. Are the particular "early colonizing" fungi necessary for healthy whitebark pine seedling regeneration present in mature forests? How do management strategies such as fire affect the mycorrhizal communities? In reforestation, ectomycorrhizal fungi are known to increase the survival of out planted seedlings in some circumstances (Cordell et al. 2000), and another objective is to assess the potential of various native ectomycorrhizal fungi as inoculum for nursery trees.

Study Areas and Methods

In late 2004 and through the summer-fall of 2005 we concentrated our field efforts on the Montana portion of the Greater Yellowstone Area and in particular: the New World District outside of Cooke City, Golden Trout Lakes near The Gallatin Crest, the Gravelly Range west of the Madison Valley and Sacajawea Peak in the Bridger Range. These are areas of low blister rust infection in the northern GYA. Sites were visited a total of 25 times over 1.5 field seasons. Sporocarps of ectomycorrhizal fungi were collected on the sites, identified to species using microscopic techniques, and vouchers specimens dried and deposited in the MONT Herbarium at MSU. Selected species were cultured in Modified Melin Norkrans for later inoculation of seedlings. Limited root samples of seedlings were analyzed for morphotypes of mycorrhizal fungi (a measure of taxon/species richness) and identified by sequencing the ITS region, and then using either ITS-RFLP matching to our own known sporocarps or by using a BLAST search and phylogenetic analysis (Gardes and Bruns 1996).

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At present we are completing the species list, analyzing information on the ecology of the native ectomycorrhizal fungi for this area, examining microsite variation, initiating a study on fire sites, and working towards inoculation of whitebark pine seedlings with native fungi originally found with this species from burned and unburned whitebark pine forests.

Preliminary Results and Discussion

To date, we have catalogued about 47 species of native ectomycorrhizal fungi from whitebark pine forests and have confirmed that over 43% of these species are associated with P. albicaulis (and not with spruce, fir, or other ectomycorrhizal plants in the vicinity). In all, 24 morphotypes and 10 confirmed species as identified by sequencing and ITS-RFLP matching occurred on seedlings. Taken as a whole, the mycorrhizal flora of whitebark pine appears somewhat limited at these high elevation harsh habitats. There is a surprising overlap of fungal species among sites that suggests the mycorrhizal flora may be very specific for Pinus albicaulis, but data are not completely analyzed.

Ectomycorrhizal fungal species	New World	Golden Trout Lakes	Gravelley Range	Sacajawea Peak
1. in white bark pine forests	29	7	18	6
2. confirmed with whitebark pine trees	13	2	11	4
3. confirmed on whitebark seedling roots	19	15	6	6

Table 1. *Species diversity of Ectomycorrhizal fungi in whitebark pine forests in the Greater Yellowstone Area. Species with a confirmed association with whitebark pine are those which either fruited in pure stands (2) or were identified on roots with ITS-RFLP matching or a blast search (3). Collecting effort varies for the sites and more visits to the New World site is likely reflected in higher species numbers.*

Taxonomic Groups

Of the fungi associated with whitebark pine, a majority are in the Cortinariales, Boletales and Hygrophoraceae. This might be expected given the large diversity of fungi in the former group in the western boreal forests of North America and the close association of the latter group with the genus Pinus. The third group contains fungi of cold climates. Many of the species we are finding in whitebark pine forests are not well known. For the genus Cortinarius many of the taxa are unpublished and have provisional names. For the Boletales, some appear to be restricted to Pinus albicaulis and Pinus monticola (western white pine) in western North American, some to the genus Pinus and others to stone pines globally (Moser 2004).

In addition, a large portion of species that occur with whitebark pine are either hypogeous (fruit underground) or secotioid (do not open for spore dispersal). Spores of these species rely primarily on small mammals such as squirrels and voles to distribute their spores (Maser et al 1978). Another surprising aspect is the discovery of many fully mature mushrooms fruiting either just at the soil surface or totally buried. This was particularly true for the genus Russula which has many hypogeous relatives, but we found only mushroom-forming species below ground. We also have records of mycorrhizal fungi placed in trees by squirrels drying them as winter food. All this suggests a strong evolutionary trend against epigeous (above ground) fruiting and for animal dispersal of spores. It adds another link in the list of tree-mammal-fungal connections. In addition, grizzly bears are known to consume sporocarps of mycorrhizal fungi in lodgepole pine forest when whitebark pine trees are present (Mattson et al. 2002), and it is likely that some of the species on our list are involved.

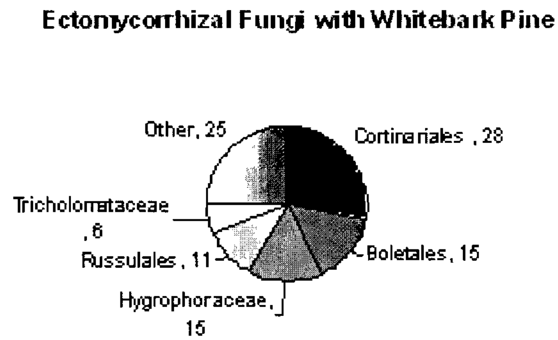

Fig. 1. *Major taxonomic groups and species numbers of ectomycorrhizal fungi with whitebark pine for the Greater Yellowstone Area in one year of study, 2004-2005.*

To date we have isolated over 11 taxa (25% of species) of native ectomycorrhizal fungi from natural whitebark pine forests and are working on a few from managed systems. Many species of ectomycorrhizal do not grow in culture or do not grow well enough to be of use for inoculation of seedlings. Most of the species we presently have in culture grow well on a nutrient media developed especially for ectomycorrhizal fungi. These native species will be used to inoculate whitebark pine seedlings to test for formation of mycorrhizae under greenhouse conditions. Some species will be of interest for their potential to enhance drought tolerance in plants, and others for possible antagonistic action against seed or roots pathogens. This information could be of importance for the restoration program using resistant seedlings.

Future directions and final comments

The first part of our research should be completed in 2006, and we are now moving into a wider range of whitebark pine forests and systems managed for whitebark pine establishment (particularly those managed by fire or felling, with and without outplants). The species list continues to grow and since fungi fruit irregularly in high elevation habitats it will take several years to complete. We are continuing to capture ectomycorrhizal fungi with potential for establishment and maintenance of this magnificent pine.

Acknowledgments

We want to thank Diana Tomback, Bob Keane,

Julie Shea, Mary Hektner, Dan Reinhart, Roy Renkin, and Melissa Jenkins for their interest and help with our project. We look forward to interacting with others interested in this research.

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Guidelines for Planting Whitebark Pine

Glenda L. Scott and Ward W. McCaughey

Scott is Regional Reforestation Specialist with USDA Forest Service, Region 1, Missoula, MT, glscott@fs.fed.us. McCaughey is Research Forester, USDA Forest Service, Rocky Mountain Research Station, Missoula, MT, wmccaughey@fs.fed.us.

There is limited research on planting whitebark pine but knowledge about the physiological and ecological characteristics of the species is increasing. With this knowledge, and the experiences from a few reforestation specialists from Montana and Idaho forests, we have outlined some guidelines for planting prescriptions.

One plantation trial for whitebark pine began in 1987 on Palmer Mountain on the Gallatin National Forest near Gardiner, Montana. One portion of the study evaluated planting survival based on physiographic location across the study site.Trees were planted in rows starting in a swale, then up a 15% slope, over a ridge, and across a bench of less than 9% slope. While long-term results are not yet available, early results show the highest survival on drier ridges and gentle benches. Total survival decreased over the eleven year period with the large drop being in the first five years after planting. Eleven years following planting, survival was highest (47 and 39 percent) on the ridges and benches and lowest on the swales and steep slopes adjacent to the swale. Survival differences are probably due to the combined effects of other conditions based on topographic position. Gopher activity was visually higher in the swales and adjacent slopes where soils were deeper and grasses and forbs more abundant.

A second whitebark pine plantation study at Cooke City, Montana, showed that from 1992 to 2001, survival on moist sites dropped from 100 to 50 percent. However, on dry sites survival only dropped to 86 percent. Again, drier more severe sites with less vegetative competition and animal disturbance were better suited for whitebark pine survival. Long-term results of this study along with results of a variety of other studies, tree row survival surveys, and field observations relating to site conditions, planting seasons, and tree spacing will further aid silviculturists in refining prescriptions. Results and long-term survival are just beginning to become available for some research studies.

A regeneration study in western Montana showed that whitebark pine seedlings survive better when grown in association with grouse whortleberry (Vaccinium scoparium). While vegetation competition is not favorable for whitebark pine survival, Perkins (2004) found that seedlings survived best when planted with grouse whortleberry or in bare ground. Poorest survival was in association with sedges typically found on moister sites. Seedlings planted in bare ground with no site amelioration survived at intermediate levels. Her study goes on to identify a positive correlation to growth when grouse whortleberry was present, better than even bare ground. While there may be positive effects caused by whortleberry reducing soil moisture evaporation and shade protection, its greater benefits may be by assisting seedlings via a mycorrhizal relationship or other below ground interactions. Further studies are necessary but it appears that it is not by accident that whitebark pine and grouse whortleberry are commonly found together.

Although WBP survives and can thrive at lower elevations and on more productive sites, it has lower survival due to greater impacts from competition and high gopher problems. It also does not tend to dominate and create wide crowned individuals because of competition and crowding from faster growing species. Cone crops on small crowned trees grown in dense stands are less than crops from open grown trees. The real niche for whitebark pine tends to be on shallow well-drained soils, steeper slopes, and windy exposures.

The best chance for success in restoring and maintaining whitebark pine is from planting seedlings with blister rust resistance from a natural selection processes. Despite whitebark's high level of rust susceptibility, individual trees do express very notable resistance to blister rust (Hoff and others 1994). Cones should be collected from trees expressing resistance as a first but critical step towards improving rust resistance.

Seeds need adequate time in a conditioning environment to mature to the point that they will have adequate germination potential. Since predation of cones by squirrels and Clarks nutcrackers will likely precede adequate ripening, it is necessary to install cone protecting cages early in the summer (Burr and others 2001). Cones should be examined to determine maturity before making final collection when embryo to total seed length ratios are above 0.65 and after endosperm to total seed length ratios reach 0.75 percent or above.

Nutcracker planted seeds are stratified by overwintering in cold environments where they are subjected to long periods of cold-moist conditions. These conditions help the seeds to overcome physical and physiological barriers to germination. Dry spring conditions reduce potential for seeds to imbibe water resulting in seedlings lying dormant for that year. Whitebark pine seeds can delay germination for up to three years after planting, then germinating when spring moisture is adequate. In certain wet years, germination can continue throughout the summer and into the fall.

Taking these lessons into the greenhouse, nursery experience shows that there are a variety of techniques to break various dormancy mechanisms. The simplest method is cold stratification for very long periods of time- over 4 months. Research shows that 45 to 60 days is the minimum needed, however, it may not yield the highest germination rates. To increase germination reliability, the Forest Service's Coeur d'Alene Nursery has developed a multiple step protocol for whitebark pine (Burr and others 2001).

Two growing seasons are required to produce plantable nursery grown seedlings. Germination occurs throughout the first growing season. Primary needles may develop the first season but they are most prevalent during the second growing season. Aggressive root development generally occurs. Recently emerged seedlings are vulnerable to a variety of damaging agents including heat damage. Even with increased stem diameter, seedlings are easily damaged, and thus must be shaded during the warmest part of the growing season. Nursery growers observe that whitebark pine seedlings go into dormancy quite easily and early, thus maintaining a long photoperiod will encourage a longer growing period.

Target seedlings are ready for outplanting in early July in Montana with bud set complete and root and caliper growth set to continue in the field. The soil moisture of the planting sites is generally good at this time due to late snow melt. Districts should plan for very short tree storage from the time of extraction to planting. If soil moisture is expected to be good in the fall, the nursery can continue the growing regime and extract seedlings just before fall planting. Root growth may occur but most will occur in the spring. Our growers are using a large container, either a ray leach 10 or super cell to achieve the best seedlings.

Based on ecological and physiological information, planting trials and experience in the Northern Rocky Mountains, we recommend the following guidelines be included in planting prescriptions.

1. Reduce overstory competition to increase light and improve the effective growing season.

2. Reduce understory vegetation, especially grasses and sedges to lessen competition for available soil moisture, however, do not aggressively remove grouse whortleberry during site preparation.

3. Avoid planting in swales or frost pockets considering the topographic position as well as the actual planting spot. Young whitebark pine seedlings do not appear to be frost hardy during the growing season. Ridge tops or exposed slopes are suitable.

4. Provide shade and protection for newly planted trees to improve water utilization and reduce light intensity and stem heating. Planting by stumps or other stationary shade is important.

5. Plant where there is some protection from heavy snow loads and drifting snow. Stumps, rocks, and large logs are favorable microsites.

6. Do not overcrowd planted trees to avoid long-term inter-tree competition. Open grown trees have the largest crowns and produce the most cones. Tree form is not as important since the purpose is to establish trees for long-term regeneration, cone production purposes, aesthetics, and a variety of other reasons and not timber production. Adjust spacing guides based on expected survival. At 50 percent survival, planting density should be 6.1 m x 6.1 m (20 ft x 20 ft) producing 247 live seedling per hectare (100 live seedlings per acre).

7. Plant when there is adequate soil moisture. Summer and fall planting have been successful and avoid the need for expensive snow plowing to reach the site.

8. Plant large, hardy seedlings with good root development.

Conclusion

Planting whitebark pine is only a small part of the whitebark pine restoration strategy. Enhancing conditions for natural regeneration with prescribed fire or managed wildland fire are major actions that will make significant contributions to restoration. With proper attention to planting prescriptions and ensuring appropriate nursery culturing regimes, we can augment blister rust resistance and survival of planted trees where natural seed sources and natural regeneration are limited.

Genetics programs are testing for genetically improved seed patterned after white pine and sugar pine blister rust resistance programs which will be a great aid in restoration. However, where opportunity exists to plant whitebark pine, we cannot afford to wait on the development of rust resistant tree stock.

Throughout much of its range, silviculturists are initiating planting whitebark pine as one small tool in their bag of management options. Planting prescriptions for whitebark pine are similar to those for other species on harsh sites but whitebark pine fills a niche that we would typically avoid planting with other conifers. With continued monitoring in the field and with research studies, we can refine the prescriptions for survival, increase populations of rust resistant trees, and contribute to the population of regenerating whitebark pine. Working with our nursery partners in developing an efficient and affordable growing regimen that develops target seedlings is the key to planting success for whitebark pine.

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What's Hot in Whitebark Pine Publications?

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Here are some recent publications about whitebark pine. First, Kristen Waring has described the effects of beetle attacks after whitebark pine restoration treatments in Idaho.

Waring, K. M., and D. L. Six. 2005. Distribution of bark beetle attacks after whitebark pine restoration treatments: a case study. Western Journal of Applied Forestry 20:110-116.

Then, she and Kevin O'Hara summarized literature from many studies and put together a set of silvicultural strategies for forest ecosystems of the United States affected by introduced pests.

Waring, K. M., and K. L. O'Hara. 2005. Silvicultural strategies in forest ecosystems affected by introduced pests. Forest Ecology and Management 209:27-41.

In another paper, Andrew Bunn and others describe the spatial variation of strip-bark trees in climax whitebark pine stands in the greater Yellowstone area.

Bunn, A. G., R. L. Lawrence, G. J. Bellante, L. A. Waggoner, and L. J. Graumlich. 2003. Spatial variation in distribution and growth patterns of old growth strip-bark pines. Arctic, Antarctic, and Alpine Research 35:323-330.

Next, Elizabeth Campbell and Joseph Antos describe successional sequences after disturbance of whitebark pine/subalpine fir forests of southern British Columbia.

Campbell, E. M., and J. A. Antos. 2003. Postfire succession in Pinus albicaulis - Abies lasiocarpa forests of southern British Columbia. Canadain Journal of Botany 81:383-397.

Last, Bryce Richardson and company tried to determine flight distances of the Clark's nutcracker from DNA to describe nutcracker caching behavior at several scales.

Richardson, B.A., N.B. Klopfenstein, and S. J. Brunsfeld. 2002. Assessing Clark's nutcracker seed-caching flights using maternally inherited mitochondrial DNA of whitebark pine. Canadn Journal of Forest Research 32:1103-1111-1107.

Please contact me if you know of any other recent publications that might be interesting to people managing or studying whitebark pine. ■

The Physiological Cost of Reproduction in Whitebark Pine

Anna Sala, Kozue Asakawa, Sylvain Delzon
Division of Biological Sciences, University of Montana, Missoula

The production of highly nutritious seeds in whitebark pine is thought to require substantial amounts of resources stored in trees. During the summer of 2005 we compared morphological traits and photosynthetic rates of cone-bearing branches, branches with no cones, branches with cones removed early in the season and branches with older foliage removed. Cone bearing branches were thicker (higher diameter) than non-bearing branches and had higher total needle biomass. Cone production did not reduce the production of needles the following year. Surprisingly, one-year-old needles of cone-bearing branches had significantly lower photosynthesis rates than in non-bearing branches and branches with cones removed . These preliminary results suggest that in spite of being a carbon sink, cone and seed production limits photosynthesis of one-year-old needles. This is probably because nutrients are diverted from foliage to developing seeds and are not available for the photosynthetic machinery. Heavy cone crops may require very large amount of resources.■

Abstracts of Presentations at WPEF's September Meeting

[Presenters Ken Gibson, Steve Lamar, Shawn McKinney, Anna Sala, and Saskia van de Gevel provided more-detailed summaries of their presentations, which appear in this issue. Below are brief abstracts of the remaining presentations.]

Climatic Response at Treeline in Whitebark Pine Ecosystems from Mineral Peak, Lolo National Forest, Montana

David Mann Ph.D. student, The Laboratory of Tree-Ring Science, The University of Tennessee

A whitebark pine tree-ring chronology for the period of 1250-2003 was developed for a single site in the Lolo Natinal Forest, western Montana. These ring-width indices were used to (1) develop an achored chronology for the study site, Mineral Peak, and (2) understand climate response and its effects on growth at high elevation sites. Correlation analysis with four data sets (regional temperature, PDSI, PDO, and AMO) was conducted.

Does pollen limitation affect spatial or temporal patterns of cone production in whitebark pine?

Elizabeth Crone
Assistant Professor, University of Montana

In many plant species, including conifers, isolated plants receive less or lower quality pollen and produce fewer seeds. In at least some plant species, pollen limitation synchronizes mass seeding. Is pollen limitation important for whitebark pine? Elizabeth will present preliminary data, and request input on future research directions.

Predicting Whitebark Pine Cone Production

Eliot McIntire
Affiliate Professor, University of Montana

Whitebark pine trees vary the number of cones they produce across years. In some instances, they may alternate good and bad years, but historically this is not a general pattern. Because of this variability, knowing when and where cones are being produced in a given year becomes important for a number of ecological processes. In this presentation, Eliot describes the effort and successes to predict and understand cone production in whitebark pine.

Fire, beetles, blister rust: case studies from Waterton Lakes National Park

Dr. Lori Daniels and Carmen Wong (Ph.D. student), University of British Columbia

Using tree rings, Lori and Carmen have reconstructed the dynamics of two whitebark pine stands (Summit Lake and Glendowne Ridge) in Waterton Lakes National Park. The stands had been affected by fire, mountain pine beetle and blister rust, with the latter two disturbances causing decline and death of canopy trees. Regeneration of whitebark pine was limited and seedlings were slow growing. Neither counts of branch whorls or bud scars yielded accurate estimates of seedling ages compared with ring counts of basal disks. This pilot study was expanded in 2005; Lori and Carmen will outline their regional study.

Ghost forests, global warming, and the mountain pine beetle (Part II)

Jesse A. Logan Project Leader, Western Bark Beetle Project, Rocky Mountain Research Station.

The current widespread mountain pine beetle outbreak in whitebark pine is part of a larger phenomena of unprecedented bark beetle outbreaks that are occurring from Mexico to Alaska. A warming trend that began in the mid 1970s has allowed the mountain pine beetle to invade new habitats that were formally too harsh. In this respect, mountain pine beetle has become an invasive native species. The unique outbreak characteristics of mountain pine beetle in whitebark pine are described and compared to those expressed in more typical hosts, such as lodgepole pine. ■

Nutcracker Notes Available at University Library

The University of Montana's Mansfield Library in Missoula is a subscriber and maintains a complete collection of Nutcracker Notes, starting with Issue 1, fall-winter 2001. This collection is available through inter-library loan services to other institutional libraries.

The Whistler Whitebark Pine Conservation Project

Bob Brett, Whistler Naturalists;
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Data analysis by Carmen Wong, University of British Columbia, Tree Ring Lab

The Whistler resort's claim to fame is skiing. Skiing, and more recently snowboarding, have drawn people to Whistler since the ski hill opened in 1966. In 2010, the Winter Olympics come to town. The Olympic TV coverage will no doubt include vistas with whitebark pines, but it's unlikely any commentators will mention them. Too bad. It would be a great way to raise the profile of whitebark pine and its precarious hold on existence.

The Whistler Naturalists, a local non-profit group, have been working to improve the tree's fortunes locally through its Whitebark Pine Conservation Project.

Whistler is on the western edge of whitebark pine's range and very close to one of the North American entry points for white pine blister rust (Vancouver in 1910). In spite of its early arrival to the Whistler area, overall mortality from the rust appears to less than in some other areas. At Whistler, whitebark pine is primarily near the alpine tree line, which occurs at an elevation of about 1800m. Some full-sized individuals descend into the closed forest on warm-aspect slopes down to about 1650m, but most of the population consists of smaller trees at tree line or as scattered krummholz above tree line.

The Whitebark Pine Conservation Project

The primary goal of the project is to retain whitebark pine as a tree line species at Whistler. The Whistler Naturalists also showcase whitebark pine since it is such an excellent example of ecological connections between plants, animals, and their environment. We began the project in 2000 by collecting cones. Seedlings from this collection were outplanted on Blackcomb Mountain in 2002 and 2003. Since then, we have collected additional seeds (few of which have germinated) and monitored the survival and growth of the planted seedlings.

Planting Results to Date

We planted two groups of 2-year old seedlings, 200 in 2002 and an additional 200 in 2003. (Both batches were from the seeds collected in 2000 that were processed differently.) The 2002 seedlings were planted in five blocks, each with 40 seedlings (n=200). The site was a natural opening dominated by sedges (mainly Carex spectabilis), with a lesser cover of pink mountain-heather (Phyllodoce empetriformis) and Sitka valerian (Valeriana sitchensis). The 2003 seedlings were planted in four blocks, each with 50 (one was dead on arrival, so n=199). The area available for planting had variable vegetation, so the blocks were located in four distinct vegetation types (named after their dominant species): anemone-valerian (Anemone occidentalis and V. sitchensis), spreading phlox (Phlox diffusa), partridgefoot (Luetkea pectinata); and pink mountain-heather.

The good news is that the seedlings are doing well. Approximately 75% of the seedlings are still alive, though they're not breaking any growth records. Mortality seems to have stabilized since only 19 of the original 399 seedlings died in the past year, compared to 61 in the previous year.

		Year of Planting	
		2002 Seedlings	2003 Seedlings
Years	1	85%	85%
Since	2	68%	80%
Planting	3	64%	

Table 1: *Overall seedling survival. Survival curves generally flatten after an early period of high mortality (that is, they have negative exponential curves). It is too early to conclude too much, but it appears this flattening (lower rate of mortality) has already occurred for both groups of seedlings, but one year earlier and with higher survival for the 2003 seedlings. The difference is likely explained by the excellent growing conditions this year compared with the droughty conditions in both of the previous years.*

Clipping by rodents (or other animals) was another cause of mortality. Of seedlings planted in 2002, 7% were apparently killed by clipping. No clipped seedlings have been observed among the 2003 seedlings. Survival differed between blocks. Although the lack of replication precludes statistical analysis, some trends are worth pursuing.

The planting site for the 2002 seedlings was relatively consistent for all five blocks, yet one (Block 5) showed much higher mortality (Table 2). Three years after planting, survival on the other four blocks is relatively consistent, and far higher than Block 5. Block 5 sustained most of its mortality in the first two years which suggests it was more affected by drought than the other blocks.

Block	2003	2004	2005
1	95%	75%	65%
2	83%	73%	73%
3	85%	73%	68%
4	90%	75%	73%
5	70%	45%	43%

Table 2: *Survival by block for seedlings planted in 2002. n=40/block.*

Survival for the 2003 seedlings appears also to be related to moisture availability (Table 3). The first two blocks, which occur on well-drained slopes, had lower survival than the second two blocks, both of which occur on flatter ground with later snowmelt.

Block	2004	2005
Anemone-Valerian	78%	64%
Phlox	77%	73%
Partridgefoot	92%	88%
Heather	96%	96%

Table 3: *Survival by block for seedlings planted in 2003. n=50/block.*

Future Challenges and Opportunities

Our project has seen some successes, notably the involvement of many volunteers in putting together our small planting trial. But we suffer from a number of challenges, including:

(a) poor cone years since 2002;
(b) low germination of seeds; and
(c) lack of an effective long-term strategy.

At the same time, we have some opportunities, especially that we are in a very high-profile area. Exposure for the project will increase in coming years, both because of the Olympics and because of expanded summer visitation. In the past, summer

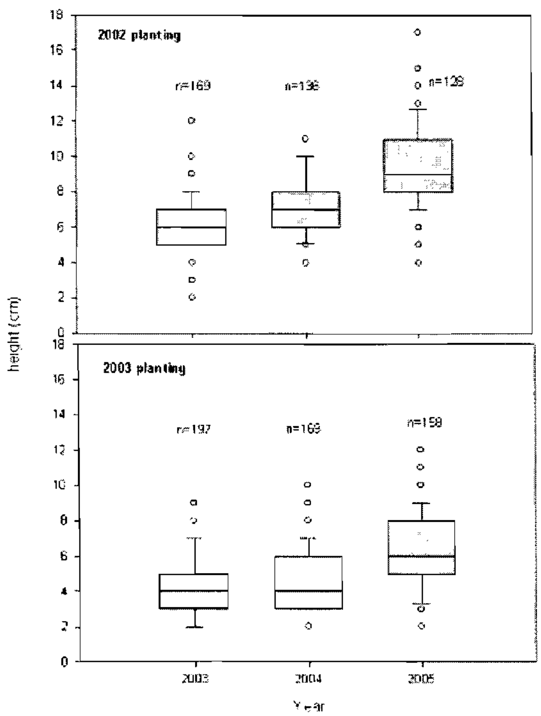

Figure 1: *Annual height growth of whitebark pine seedlings (n = number of surviving seedlings). The median height for each year is shown by the line in each box. Boxes contain 50% of the measurements, circles indicate outliers, and whiskers show 5th and 95th percentiles. N.B. In 2003, seedlings planted in 2002 were one year older than those planted in 2003 (three years-old versus two years-old, respectively).*

visits to the mountain have been approximately 200,000 people (versus >2 million in winter). This number will rise now that Whistler-Blackcomb has decided to re-open its Seventh Heaven trail system which traverses our restoration areas.

Whistler-Blackcomb recently upped the ante when it announced plans for a $45 million, four kilometre-long gondola to link Whistler and Blackcomb Mountains. When it opens in 2007, we will have the potential for many more thousands of people to view whitebark restoration in Whistler, and therefore many opportunities to attract interest and partners. (Ironically, the Blackcomb station for the tram will displace the cone trees we have relied on for past collections.)

That said, lack of financial support has not been our major challenge to date. We have benefited from the support of both the Community Foundation of Whistler and the Whistler-Blackcomb Employee Environmental Fund. Local volunteers from the Whistler Naturalists and Whistler-Blackcomb are keen to participate, as long as there are cones to collect and trees to plant.

Our main challenge is to come up with a long-term plan. Yes, we can continue growing seedlings and planting them on both mountains (assuming a source of seeds), but there is no guarantee this will help much. From my observations, most trees are dying from blister rust before they reach sexual maturity so planting may just delay the species' ultimate demise.

A last caution I should add is that purely volunteer-based efforts such as ours can be a bit difficult to undertake unless there is a core of committed people who are available each year to do the collecting, planting, monitoring, and whatever other activities are necessary.

If you have any questions about, or suggestions for, our Whitebark Pine Conservation Project, please contact me (Bob@SnowlineReserach.ca; 604-932-8900).

Acknowledgements: Seedlings were germinated and grown by Dave Kolotelo (BC Ministry of Forests) and Andy Bower (UBC). Keen volunteers include: Jodie Krakowski and Jed Cochran (UBC); Alana Hamm, Kirby Brown, and Arthur deJong (Whistler-Blackcomb); and Veronica Woodruff, John Hammons, and many other Whistler Naturalists. We also appreciate funding support from the Community Foundation of Whistler and the Whistler-Blackcomb Employee Environmental Fund. ■

ANNOUNCEMENTS

Whitebark Outdoor Display: Available for Purchase

The Whitebark Pine Ecosystem Foundation has received the beautiful educational signboard pictured on the inside front cover (bottom), and is offering it for sale, with proceeds to benefit our programs. The signboard is especially well-suited for placement near whitebark pine restoration sites. It tells the story of whitebark pine and its ecosystem, and why fire is used in ecosystem restoration. The signboard (approximately 3-foot by 4-foot) is made of fiberglass and comes complete with an aluminum stand. The sign was designed by WPEF board member Bob Keane, who has installed similar signboards at 2 sites in the Northern Rockies. The sign and stand are built to last more than 10 years in the outdoors. Sign and stand cost $1700 to produce, but WPEF is offering it for $1000 and we will consider a "best offer" for less than that amount if necessary. Those wishing further information can contact Keane [rkeane@fs.fed.us].

Pacific Coast Whitebark Pine Symposium, August 2006

Diana F. Tomback

Representing the Whitebark Pine Ecosystem Foundation, I attended an organizational workshop for a 2006 whitebark pine symposium that focuses on Pacific coast states and British Columbia. The primary movers and shakers for this event were Sheila Martinson of USFS Region 6 and Susan E. Johnson, Umpqua National Forest. Ron Mastrogiuseppe, of the Crater Lake Institute and an active member of the WPEF, deserves credit for communicating the need for such a symposium, in light of the ongoing decline of whitebark pine at Crater Lake National Park.

The organizational meeting was held from October 4 to 7 at the Community Center in Crater Lake National Park, hosted by Michael Murray, Park ecologist and a former whitebark pine researcher. The meeting was well attended, especially the first day, with about 40 people. The attendees were charged with two goals: brainstorming to identify what was not known about whitebark pine in the coastal states and program development for the 2006 symposium. We were treated to a spectacular field trip, organized and led by Michael Murray, that took us through whitebark pine stands around the park. The impacts of blister rust and mountain pine beetle on the picturesque trees around the rim above the lake were sobering.

On the last day of the meeting, a symposium organizational committee was assembled, comprising Ellen Goheen (Forest Health Protection) as the lead, and Richard Sniezko (Dorena Genetics Resource Center), Sheila Martinson, and Susan Johnson as point people, as well as other highly committed volunteers. Follow up work has since established the dates and likely location for this symposium: August 27 to August 31, 2006, at Southern Oregon University, Ashland, Oregon. The symposium will include a field trip to Crater Lake National Park. Papers will focus on Pacific Coast ecosystems, but contributors with new and general information about whitebark pine will be encouraged to present talks as well. This symposium is expected to generate a proceedings. Mark your calendars!

WPEF Annual Meeting at Sun Valley, Sept. 29-Oct. 1, 2006

WPEF board member and area ecologist for central Idaho, Dana Perkins, has arranged a spectacular venue for our 2006 annual meeting. Central Idaho is home to some of the most extensive whitebark pine-dominated forests, the oldest and largest whitebark pines, and to communities of both whitebark and limber pines in some areas. On Saturday and Sunday, Sept. 30-Oct. 1, WPEF's annual conference will be held at Sun Valley Lodge and we will have a guided tour of nearby whitebark pine communities. The WPEF board meeting (open to all members) occurs on Friday, Sept. 29. A block of rooms in the historic Sun Valley Lodge has been reserved at a special rate of $99 per night, which meets federal employee per diem for this resort area. Details of the agenda will appear in the spring-summer 2006 issue of Nutcracker Notes and on our web site [www.whitebarkfound.org] by next June. For information about Sun Valley see [www.sunvalley.com].

Marriage Strikes WPEF Board

Congratulations are in order for WPEF's Secretary, Helen Smith and WPEF member Greg Munther, who were married in September and moved to a country home at Arlee, Montana. Congratulations also for WPEF's Treasurer, Steve Shelly and his bride Karen, who were married in October and moved into a new home in the Missoula area.

Tree Tong: New Tool for Whitebark Cone Collecting

Michael Murray, Ecologist at Crater Lake National Park, [Michael_Murray@nps.gov] has been testing several techniques for accessing and gathering whitebark pine cones on the trees. These include climbing with ascending gear, free climbing, three-legged orchard ladder, and the newly developed "Tree Tong" pictured on our front cover. Murray compiled data on the efficiency of each technique for installing mesh cages around ripening cones in whitebark pine trees. He is developing a technical article that compares these techniques, but has these preliminary observations to offer:

"Overall, the Tree Tong has proved to be a very portable and time-efficient tool, while negating the need to climb where cones occur below 22' height. As a partial substitute for climbing, I believe Tongs have positive implications not only for personnel safety, but for tree damage as well."

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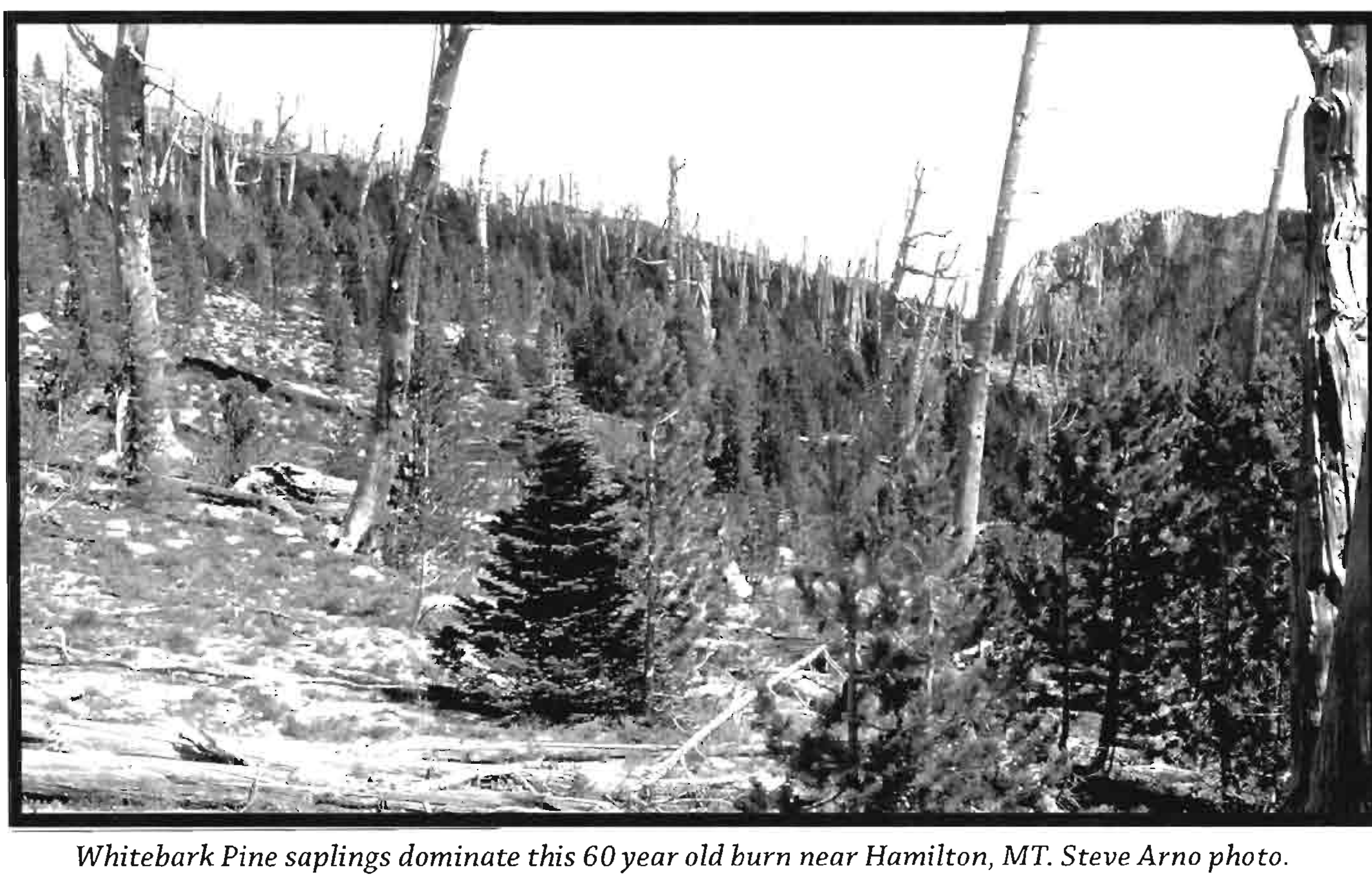
Crater Lake National Park. Frank Lang photo.



Whitebark Pine saplings dominate this 60 year old burn near Hamilton, MT. Steve Arno photo.