

Annotated Bibliography: WPBR Impact
Prepared by Brian W. Geils on Thursday, January 03, 2002

Anderson, R.L. 1973. A summary of white pine blister rust research in the Lake States. Gen. Tech. Rep. NC-6. U.S. Department of Agriculture, Forest Service, North Central Experiment Station. 12 p.

Abstract: Summarizes white pine blister rust research in the Lake States and presents status of knowledge, Important microclimatic relationships are described. Antibiotics are not effective, whereas pruning provides some control. Genetic resistance shows much promise but may be complicated by pathogenic races, The effectiveness of ribes eradication is open to question.

Keywords: eastern white pine, white pine blister rust, review

Folder: WPBR impact

Anderson, R.L. 1988. Major disease problems of conifer forests. In: Proceedings SAF National Convention, Oct. 16–19, Rochester, NY: 121–126.

Abstract: Of the hundreds of diseases that occur on conifer species in the United States, the ones causing greatest impact over large areas are fusiform rust on yellow pines in the South, dwarf mistletoe on a number of species in the West and Northeast, white pine blister rust in most places where white pines grow, and a large number of root diseases on many species throughout the United States. Annual losses to these pests are valued in the hundreds of millions of dollars. These diseases must be considered in management, because management can greatly reduce their impact.

Keywords: fusiform rust, white pine blister rust, pest impact, review

Folder: WPBR impact

Location: file

Benedict, W.V. 1981. History of white pine blister rust control—a personal account. FS-355. Washington, DC: U.S. Department of Agriculture, Forest Service. 47 p.

Annotation: The history of the white pine blister rust control in United States 1909 to 1941.

Keywords: white pine blister rust, disease control, review

Folder: WPBR impact

Location: file, pathology

Bingham, R.T. 1967a. International aspects of blister rust resistance in white pines. In: Proceedings of XIV IUFRO Congress, Munich, Germany, 1967 (Vol. III section 22): 832–841.

Annotation: Describes some of the values, opportunities, and difficulties of international cooperation of improving the resistance of white pines to blister rust. Classifies and indicates cross-breeding potential of the white pines. Suggests making collections of certain Asian species, establishing a international network of disease gardens and field test sites, and comprehensive listing of tree material available for introduction, testing, and breeding.

Keywords: white pine blister rust, genetics program

Folder: WPBR impact

Location: file

Bingham, R.T. 1983. Blister rust resistant western white pine for the Inland Empire: the story of the first 25 years of the research and development program. Gen. Tech. Rep. INT-146. Ogden, UT: Intermountain Forest and Range Experiment Station. 45 p.

Abstract: Methods, results and conclusions are reviewed for a 25-year, USDA Forest Service first-phase Research and Development program. The program goal was to attain useful blister rust resistance in western white pine. One study result is that the Service will be mass-producing second-generation, rust resistant white pines for the Inland Empire. About two-thirds of these seedlings are expected to withstand severe exposure to local races of blister rust. The resistance is based on a number of differential and uniform types. Second-phase work, aimed for fruition before the year 2000 is outlined.

Keywords: western white pine, white pine blister rust, genetics program, review

Folder: WPBR impact

Location: file, pathology

Bingham, R.T.; Gremmen, J. 1971. A proposed international program for testing white pine blister rust resistance. *European Journal of Forest Pathology*. 1:93–100.

Abstract: A two-stage, international blister rust resistance test program proposed by the IUFRO Committee on (resistance to) White Pine Blister Rust is described. First, there would be a reevaluation of "naturally" resistant Eurasian white pine from near the original white pine: *Cronartium ribicola* gene center(s). Next, there would be more sophisticated testing of North American white pines developed by artificial selection and controlled crossing. Key test centers are needed in Siberia, south-central Asia, the Baltic-North Sea countries, and eastern and western North America. Initial Committee inquiries indicate that 5 of the core cooperators could commence testing in the near future.

Annotation: Includes an interesting introduction on the history and impacts of the white pine blister rust (evolutionary aspects, economic and biologic impacts, and restoration of North American white pines).

Keywords: white pine blister rust, genetics program

Folder: WPBR impact

Brown, H.D. 1972. Guidelines: Pruning white pine in the Lake States for blister rust control. S-72-9. St. Paul, MN: U.S. Department of Agriculture, Forest Service, S&PF Field Office. 12 p.

Abstract: Pruning white pine as one method of blister rust control has been practiced in the Lake States for nearly a decade. The guidelines in this report were developed to make the program more practical and to make it consistent throughout the Lake States. These guidelines include: minimum white pine stocking, minimum acreage, minimum annual lethal infection, minimum non-weeviled trees per acre, maximum number of trees per acre to be pruned and height of pruning.

Keywords: white pine blister rust, pruning

Folder: WPBR impact

Byler, J.W.; Parmeter, J.R., Jr. 1979. An evaluation of white pine blister rust in the Sierra Nevada. Report 79-3. San Francisco, CA: U.S. Department of Agriculture, Forest Service, Region 5, Forest and Disease Management. 19 p.

Abstract: In the late 1960s the Forest Service began a review of the blister rust situation in California. Surveys were made in the northern Sierra Nevada to determine the incidence of rust infection and damage to sugar pine. More than 50% of the trees were infected in several incidence survey units, and most infected sugar pine in those areas were lethally infected. However, the mean level of infection was below 20% even though the incidence survey was made in and around the oldest known infection centers in the Sierra Nevada, centers that had been active for two to three decades. Furthermore, the damage survey indicated that many infected, pole-sized and larger trees will reach merchantable size.

Annotation: Several management suggestions are given.

Keywords: sugar pine, white pine blister rust, damage survey, pest hazard, disease spread

Folder: WPBR impact

Location: file

Geils, B.W. 1993. An outline for proposed research and cooperative studies on blister rust of southwestern white pine. In: Allison, J.R., comp. 41st Annual Western International Forest Disease Work Conference; 1993 September 13-17; Boise, ID. San Bernardino, CA: U.S. Department of Agriculture, Forest Service, San Bernardino National Forest: 103-111.

Annotation: History, potential impacts. Site-specific rust hazard model, ecological effects assessment, genetic evaluation, economic analysis.

Keywords: white pine blister rust, SW white pine

Folder: WPBR impact

Location: reprint

Geils, B.W. 2001. Impacts of white pine blister rust. in: Fosbroke, S.L.C.; Gottschalk, K.W., eds, Proceedings, U.S. Department of Agriculture interagency research forum on gypsy moth and other invasive species 2001; 2001 January 16–19; Annapolis MD. Gen Tech. rep NE-285. Newton Square PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 61–64.

Abstract: The introduction of *Cronartium ribicola* Fisher to North America early in the 1900s began the first major forest disease outbreak American forestry seriously confronted. White pine blister rust has caused significant impacts in eastern North America, the Lake states, Pacific and Rocky Mountain forests. Blister rust is still a damaging pathogen and important ecological factor in forests of those regions. It is now spreading in the Great Basin, Southern Rocky Mountains, and Southwestern forests, and may soon reach northern Mexico (if it has not already). Because white pines are so highly valued, their loss to blister rust and our efforts to mitigate those losses have generated incalculable impacts—socio-economic, political-administrative, ecological, scientific, and aesthetic. The history of blister rust in North America has already gone through two management cycles (eradication and integration), and I propose it is entering a third (adaptation).

Keywords: review, white pine blister rust

Folder: WPBR impact

Location: reprint

Gunderson, L.H.; Holling, C.S.; Light, S.S., eds. 1995. Barriers and bridges to the renewal of ecosystems and institutions. New York, NY: Columbia University Press. 593 p.

Annotation: This book explores ways for active adaptation and learning in dealing with uncertainty in the management of complex regional ecosystems. Introduction. Case studies. Essays. Synthesis.

Keywords: ecosystem mgt, philosophy, review

Folder: WPBR impact

Location: shelf

Hagle, S.K.; McDonald, G.I.; Norby, E.A. 1989. White pine blister rust in northern Idaho and western Montana: Alternatives for integrated management. Gen. Tech. Rep. INT-261. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 35 p.

Abstract: Western white pine management has undergone dramatic change since the introduction of white pine blister rust. This report summarizes major events and presents current technology for foresters managing stands in the western white pine type of Idaho and Montana. Site-specific management alternatives are developed through the use of a dichotomous key. Supporting information is provided in a series of subject appendixes. We discuss the concept of Rust Hazard and its application to stand management. Approaches to using rust resistance and intermediate stand treatments are explained. Regardless of stand management intensity, this information should provide insight into both the influence of white pine blister rust on stands and the effects of stand and site manipulation on the disease. [Preface]

Keywords: western white pine, white pine blister rust, review, pest hazard, mgt. guide

Folder: WPBR impact

Location: file, pathology

Hann, W.J. 1989. Landscape and ecosystem level management in whitebark pine ecosystems. Symposium on Whitebark Pine Ecosystems: Ecology and Management of a High-Mountain Resource, Bozeman, MT, March 29–31: 335–339.

Abstract: To provide adequate resource protection in alpine and subalpine areas, managers need to expand their perspectives and focus on ecosystem and landscape-level management. Single-resource and microsite focuses stymie integrated management and protection plans. A landscape perspective is outlined for the Northern Rocky Mountains, interpreting climatic, landform, topographic, and distribution factors and their relation to vegetation mosaics.

Keywords: whitebark pine, ecosystem mgt., landscape ecology

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Location: file

Hawksworth, F.G.; Conklin, D. 1990. White pine blister rust in New Mexico. In: Proceedings 38th Annual WIFDWC. 1990 September 17-21; Redding CA.: 43-44.

Annotation: White pine blister rust was found in March 1990 on southwestern white pine in the Lincoln National Forest near Cloudcroft, Otero, County, New Mexico.

Keywords: SW white pine, white pine rust

Folder: WPBR impact

Location: file

Hoff, R.J.; Bingham, R.T.; McDonald, G.I. 1980. Relative blister rust resistance of white pines. European Journal of Forest Pathology. 10:307–316.

Abstract: The frequency of six mechanisms of resistance to white pine blister rust is presented for 18 white pine species. The mechanisms are: prevention of needle lesions, reduced frequency of such lesions, premature shedding of infected needles, a fungicidal reaction of the short shoot, reactions that eliminate established bark infections, and the ability of a seedling to remain alive when infected. The importance of these mechanisms in selecting for resistance in the very susceptible North American white pines is discussed.

Annotation: *P. strobiformis* ranked 13th among 15 classes based on percent of seedlings with no infections and ranked 9th among 13 classes based on spot density.

Keywords: white pine blister rust, host resistance

Folder: WPBR impact

Location: file

Hoff, R.J.; Hagle, S.K. 1990. Diseases of whitebark pine with special emphasis on white pine blister rust. In: Symposium on Whitebark Pine Ecosystems: Ecology and Management of a High-Mountain Resource; 1989 March 29–31; Bozeman, MT. Gen. Tech. Rep. INT-270. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station: 179–190.

Abstract: Whitebark pine (*Pinus albicaulis*) has few endemic diseases that do much harm. White pine blister rust (*Cronartium ribicola* J. C. Fisch. ex Rabenh.), an exotic disease brought here from Europe, is the most damaging disease. It is epidemic over most of the range of whitebark pine. There have been 23 diseases reported for whitebark pine, including stem and branch cankers, needle casts, seed and cone diseases, stem and root decays, and dwarf mistletoes. Significant damage from most diseases have been observed only in localized areas. White pine blister rust is the only disease that is widespread and damaging over most of the range of whitebark pine, with the exception of high-dry areas such as in Yellowstone National Park. Pruning and excising cankers are good management options for saving trees infected by white pine blister rust, but only on moderately hazardous sites. On high-hazard sites, the only option is to utilize resistance. Resistance is common in whitebark pine. Several methods for using resistance to restock decimated areas are presented.

Keywords: whitebark pine, white pine blister rust, review, forest management

Folder: WPBR impact

Location: file

Hoff, R.J.; Hagle, S.K.; Krebill, R.G. 1992. Genetic consequences and research challenges of blister rust in whitebark pine forests. In: Gen. Tech. Rep. INT-GTR-309. Schmidt, W.C.; Holtmeir, F.-K., comp. Proceedings--International Workshop on subalpine stone pines and their environment. St. Moritz, Switzerland; 1992 September 5–11. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.: 118–126

Abstract: Susceptibility of whitebark pine to blister rust is reviewed. Progress is reported on studies that assess the level of susceptibility over its entire range and the existence of resistance in various stands. Two breeding approaches are discussed: (1) the traditional, where trees are selected, tested, then established in seed orchards; (2) a natural approach that aids natural processes to establish "a natural selection stand."

Keywords: white pine blister rust, whitebark pine, host resistance

Folder: WPBR impact

Location: file

Hoff, R.J.; McDonald, G.I. 1972b. Stem rusts of conifers and the balance of nature. In: Misc. Pub. 1221. Biology of rust resistance in forest trees. Proceedings of NATO–IUFRO Advanced Study Institute. 1969 August 17–24. Moscow, ID. Washington, DC: U.S. Department of Agriculture, Forest Service: 525–536.

Abstract: Total resistance of western white pine to blister rust is a composite of independent mechanism. ... There are at least two virulent races of *Cronartium ribicola* plus a third race that appears only to modify the action of the virulent races. ... A list of questions concerning the biological aspects of the white pine : blister rust system is presented. Many of these questions must be answered before a program designed to mass produce resistant seedlings can proceed with maximum likelihood of success.

Annotation: The presentation discusses pine : rust interactions in terms of balanced symbiosis and damage as interference with reproduction. In discussion, Kinloch points to the possible role of specific resistance.

Keywords: white pine blister rust, host resistance

Folder: WPBR impact

Location: shelf

Hoff, R.J.; McDonald, G.I. 1993. Variation of virulence of white pine blister rust. European Journal of Forest Pathology. 23:103–109.

Abstract: According to the literature the following evidence suggests racial variation in white pine blister rust: changes over site in general level of resistance; interactions of needle spot color types with crosses of western white pine; neutralization of specific resistance reactions; bark reactions and normal cankers of the same tree.

Keywords: white pine, white pine blister rust, host resistance, review

Folder: WPBR impact

Location: file

Hummer, K.E.; Sniezko, R. 2000. Introduction. In: Ribes, Pines, and White Pine Blister Rust. Corvallis: OR. 8–10 September 1999. HortTechnology. 10(3):514.

Annotation: The conference included a day and a half of extensive discussion plus field trips.

Keywords: Ribes, white pine, white pine blister rust

Folder: WPBR impact, Ribes

Location: shelf

Hungerford, R.D. 1977. Natural inactivation of blister rust cankers on western white pine. Forest Science. 23:343–350.

Abstract: Natural inactivation was assessed for 7 years in a population of more than 1,700 blister rust cankers (*Cronartium ribicola*) on western white pine (*Pinus monticola*) at 49 locations. Of lethal-type cankers (those in the bole or expected to reach the bole) that became inactive during the study, about 78 percent remained so. At the conclusion of the study, 33 percent of lethal-type cankers were inactive and 12 percent of infected trees were potentially saved because all cankers on them were inactive. Lack of fruiting by *C. ribicola* and the presence of the purple mold (*Tuberculina maxima*) were significantly related to subsequent inactivation. Significant differences in percent of cankers inactive existed among locations.

Keywords: western white pine, white pine blister rust, associated fungi, canker dynamics

Folder: WPBR impact

Location: file, pathology

Hungerford, R.D.; Williams, R.E.; Marsden, M.A. 1982. Thinning and pruning western white pine: a potential for reducing mortality due to blister rust. Res. Note INT-322. Ogden UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 7 p.

Abstract: Thinning and pruning were tested as potential methods for reducing mortality of western white pine (*Pinus monticola*) infected by the blister rust disease caused by *Cronartium ribicola*. Five years after treatment, thinning had increased the number of new lethal infections per tree. Pruning counteracted the effects of thinning.

Keywords: western white pine, white pine blister rust, disease control, thinning, pruning
Folder: WPBR impact Location: file

Hunt, R.S. 1998. Pruning western white pine in British Columbia to reduce white pine blister rust losses: 10-year results. Western Journal of Applied Forestry. 13(2):60–63.

Abstract: Survey lines were located in areas that had been pruned to control blister rust (*Cronartium ribicola*) 10 yr previously and adjacent control (unpruned) areas in 10 stands of western white pine. Stands were classified as densely stocked, moderately stocked, or open. Cankers were tallied and their position noted. The success of pruning varied from stand to stand. Since the stands had not been pruned at an early age, there was only a 4 to 5% reduction in threatening and stem cankers respectively, as few new cankers were initiated. Stands with the greatest increase in cankering had *Ribes* spp., were open grown, or possessed a high component of small white pine. Repruning these specific stands may be worthwhile, but in general, entering stand again to do either pruning or scribing would produce few additional healthy trees. Doing both treatments, however, may significantly enhance the number of healthy stems. To optimize the benefits of pruning, stands should be entered early and pruning should continue until a sufficient number of stems are pruned to a height of 3 m to ensure full stocking. Other species may be impediments to spores within stands, and thus they should not be pruned. Dense stands initially had less rust than open stands and could be entered later, but once spaced, they also needed to be pruned to 3 m to minimized rust infection.

Keywords: white pine blister rust
Folder: WPBR impact Location: file

Hunt, R.S. 2000. White pine blister rust, root disease, and bears. Western Journal of Applied Forestry. 15(1):38–39.

Abstract: Prior to harvest, nine root disease sites lacked any *Ribes* spp., but after harvest six supported *Ribes* spp. Surveys indicated that *Ribes* spp. and other berry plants were in greater abundance in root disease areas than in adjacently harvested areas. Seed deposition by bears and periodic flourishing in root disease areas are likely contributors to forest seed banks, On one site the blister rust incidence in white pine was 98% in the root disease area and 27% in the adjacent non-root disease area. The presence of root disease should be used to rank an area for high potential to blister rust.

Keywords: associated animals, *Ribes*, root disease, white pine blister rust, wildlife habitat
Folder: WPBR impact, *Ribes* Location: file

Hunt, R.S.; von Rudloff, E.; Lapp, M.S.; Manville, J.F. 1985. White pine blister rust in British Columbia. III. Effects on the gene pool of western white pine. Forestry Chronicle. 61:484–488.

Abstract: Cluster analyses of relative terpene abundance in foliage of western white pine trees from throughout the Pacific Northwest geographic range of the species were produced. Terpene patterns were randomly distributed among populations; no geographic or site trends were evident. Although blister rust is devastating to stands, the gene pool is widely distributed and may well be preserved without establishing gene banks.

Keywords: western white pine, white pine blister rust, population genetics
Folder: WPBR impact Location: file

Imazu, M.; Azbukina, Z.M.; Kakishima, M.; Fukushima, K.; Hishimura, K.; Miyaji, M. 2000. Identification of a rust fungus on *Pinus pumila* collected in the North Kurils, Russia. *Mycoscience*. 41:139–144.

Abstract: Morphological examination and PCR-RFLP analysis of the D1/D2 region in nuclear LSU rDNA were carried out to identify a rust fungus on *Pinus pumila* collected in the North Kurils, Russia. Morphologically, the rust from the North Kurils was similar to *Peridermium kurilense* and *Endocronartium sahoanum* var. *hokkaidoense* in the spore surface structure, dimension, and shape. In the RFLPs of the D1/D2 region it was identical to *E. sahoanum* var. *hokkaidoense* and *E. sahoanum* var. *shoanum*, but distinct from *Cronartium ribicola*. Therefore, the rust fungus on *P. pumila* collected in the North Kurils was identified as *E. sahoanum* var. *hokkaidoense*. It was also clarified that a rust reported previously as *P. kurilense* was also identical with *E. sahoanum* var. *hokkaidoense*.

Keywords: fungus, white pine blister rust

Folder: WPBR impact

Keane, R.E.; Arno, S.F. 1993. Rapid decline of whitebark pine in western Montana: Evidence from 20-year remeasurments. *Western Journal of Applied Forestry*. 8(2):44–47.

Abstract: Whitebark pine, an important producer of food for wildlife, is decreasing in abundance in western Montana due to attacks by the white pine blister rust fungus, epidemics of mountain pine beetle, and successional replacement mainly by subalpine fir. ...

Keywords: whitebark pine, white pine blister rust, bark beetle, fire ecology, plant succession, tree mortality, wildlife habitat

Folder: WPBR impact

Location: file

Keane, R.E.; Morgan, P.; Menakis, J.P. 1994. Landscape assessment of the decline of whitebark pine (*Pinus albicaulis*) in the Bob Marshall Wilderness Complex, Montana, USA. *Northwest Science*. 68(3):213–229.

Abstract: Whitebark pine provides important food for wildlife and important cover for snow retention and watershed protection in high-elevation ecosystems of the northwestern United States. In the northern Rocky Mountains, this species is being reduced at accelerated rates by blister rust, mountain pine beetle, and advancing succession resulting from fire exclusion. This study evaluates the extent and severity of the decline of whitebark pine in the Bob Marshall Wilderness Complex of Montana. ...

Keywords: whitebark pine, white pine blister rust, bark beetle, biodiversity, pest impact

Folder: WPBR impact

Location: file

Kegley, A.; Schwandt, J.; Gibson, K. 2001. Forest health assessment of whitebark pine on Pyramid Pass, Russell Mountain, and Burton Ridge in the Selkirk Mountains of the Idaho Panhandle National Forest. Report 01-8. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Region, Forest Health Protection. 11 p.

Annotation: Whitebark pine (WBP) is an important high-elevation tree species. Research has recently documented the rapid decline of WBP throughout much of the West due primarily to white pine blister rust, fire suppression, forest succession, and mountain pine beetle. This report documents data recorded during ground surveys conducted in fall 2000 well as aerial survey information for the years 1992–2000....Top-kill was a common rust symptom and indicates multiple infections over a long period. Lower infection percentages in understory may reflect increased survival of resistants or short time of exposure. Mixed results suggest no strong interaction between WPBR and MPB. Management options include use of partial cutting, tree baits, protective sprays, anti-aggregents, and re-planting with phenotypically resistant trees.

Keywords: bark beetle, damage survey, white pine blister rust, whitebark pine

Folder: WPBR impact

Location: file

Ketcham, D.E.; Wellner, C.A.; Evans, S.S., Jr. 1968. Western white pine management programs realigned on Northern Rocky Mountains National Forests. *Journal of Forestry*. 66:329–332.

Abstract: A comprehensive evaluation of problems of managing western white pine stands in national forests in the northern Rocky Mountains completed in 1966 led the U.S. Forest Service to realign its management of this and associated species. Comparative reduction in economic importance of western white pine, coupled with inability of blister rust control programs to protect white pine, strongly influenced the federal management decision.

Annotation: 1. Eradication of *Ribes* discontinued. 2. Use of antibiotics discontinued or curtailed. 3. Thinning and weeding will favor other species. 4. Planting of white pine discontinued. 5. Salvage accelerated. 6. Efforts to develop resistant pines strengthened. 7. Efforts to develop biological or chemical control expanded.

Keywords: white pine blister rust, forest management

Folder: WPBR impact

Location: pathology

Kimmey, J.W. 1969. Inactivation of lethal-type blister rust cankers on western white pine. *Journal of Forestry*. 67:296–299.

Abstract: Inactivation of blister rust cankers on western white pine was evaluated throughout the Inland Empire in a 1965 survey of 48 young stands, not treated with antibiotics. 62% of all lethal-type cankers sampled were inactive. In open stands, 67% were inactive compared to 60% in other stands; in dominant and codominant trees 66% were inactive compared to 51% in intermediate and suppressed trees. Percent inactivation was correlated with age of cankers. No cankers <4 yr. were found to be completely inactive; but 50% of the cankers were completely inactive at 8 yr., 76% at 16 yr., and 90% at 24 yr. Aecial production was reduced to 14.2% of potential on active lethal cankers and to 5.4% of potential for the entire lethal-type canker population. *Tuberculina maxima*, believed to be the principal cause of the surveyed inactivation, was found fruiting on 24% of the active lethal-type cankers.

Keywords: western white pine, white pine blister rust, associated fungi, canker dynamics

Folder: WPBR impact

Location: file, pathology

Kinloch, B.B., Jr.; Morosy, M.; Huddleston, M.E., eds. 1966. Sugar Pine: Status, values, and roles in ecosystems. *Proceedings of a symposium presented by the California Sugar Pine Management Committee. Publication 3362. Davis CA: University of California, Division of Agriculture and Natural*

Annotation: This symposium was motivated by a concern perceived by both resource professionals and lay public alike that sugar pine as a species might be in imminent jeopardy from the introduced disease white pine blister rust. ...we hope the information provided here will expose the critical gaps in knowledge as well as provide a baseline upon which to build, and thus serve as an invaluable resource for those interested in the study, management, and conservation of sugar pine.

Keywords: sugar pine, white pine blister rust, review

Folder: WPBR impact

Location: shelf

Kinloch, B.B.; Dupper, G.E. 1987. Restricted distribution of a virulent race of the white pine blister rust pathogen in the western United States. *Canadian Journal of Forest Research*. 17:448–451.

Abstract: A race of *Cronartium ribicola* virulent to a major gene for resistance to blister rust in sugar pine appears to be limited to the site where first discovered on resistant genotypes in 1978. It was not detected in inocula surveyed extensively throughout a large part of the range of blister rust in the western United States and detected only rarely in inocula surrounding the discovery site. Nor was it found attacking resistant genotypes in other test plantings either nearby or remote from this site. Rate of spread of the virulent race from the discovery site was too slow to be measured during 6 years of observation. These results imply that major gene resistance may be usable for at least one rotation of improved planting stock, while other resistance mechanisms are being developed.

Keywords: white pine blister rust, host resistance, distribution

Folder: WPBR impact

Krebill, R.G.; Hoff, R.J. 1995. Update on *Cronartium ribicola* in *Pinus albicaulis* in the Rocky Mountains, USA. In: Kaneko, S.; Katsuya, K.; Kakishima, M.; Ono, Y., eds. Proceedings 4th IUFRO Rust of Pines Working Party Conference; 1994 October 2-7; Tsukuba, Japan. Kukizaki, Japan: Forestry and Forest Products Research Institute, Forest Microbiology Section: 127-133.

Abstract: The introduction of *Cronartium ribicola* into the USA early this century has combined with other factors such as bark beetles and forest succession to devastate high elevation *Pinus albicaulis* forests in the Rocky Mountains. Because of concerns over serious losses of *P. albicaulis*, scientific inquiry has increased in the past decade. In this paper, we summarize ongoing investigation, giving special emphasis to our studies on rust resistance, and we provide advice on how our information might be used to help the species recover.

Keywords: whitebark pine, white pine blister rust, genetics program, review

Folder: WPBR impact

Location: file

Lachmund, H.G. 1926. Studies of white pine blister rust in the West. *Journal of Forestry*. 24:874–884.

Annotation: Early history of the rust. Method of spread. Barriers to the spread. Relative infection of *Ribes*.

Damage to western white pine.

Keywords: white pine blister rust, review

Folder: WPBR impact

Location: pathology

Leaphart, C.D.; Wicker, E.F. 1968. The ineffectiveness of cycloheximide and phytoactin as chemical controls of the blister rust disease. *Plant Disease Reporter*. 52:6–10.

Abstract: The antibiotic phytoactin was not an effective control for the blister rust disease of western white pine. When applied in either aerial or basal stem treatments, the results were not significantly different from those of the treatment controls. The cycloheximide basal treatment, having 26% inactive cankers four growing seasons after treatment, was significantly different from treatment controls, but was also considered to be an ineffective control of the disease for reasons given. *Tuberculina maxima*, a rust canker parasite, is definitely implicated in reduction of activity of cankers in the treatment controls.

Keywords: white pine blister rust, disease control, associated fungi

Folder: WPBR impact

Location: file

Liebhold, A.M.; MacDonald, W.L.; Bergdahl, D.; Mastro, V.C. 1995. Invasion by exotic forest pests: a threat to forest ecosystems. *Forest Science Monograph*. 30.

Abstract: For millions of years the distribution of the world's biota has been restricted by oceans and other natural barriers. During the last 100 years, human activities, especially international travel and trade, have circumvented these barriers, and species are invading new continents at an increasing rate. Biological invasions of insect, plant, and fungal pest species often caused substantial to forest ecosystems as well as having severe socioeconomic impacts. The invasion process is composed of three phases: arrival, establishment, and spread. Management of pest invasions focuses on preventing arrival, establishment, or spread. Nine case histories are presented that illustrate the invasion process via details of the arrival, spread, and impact, and management of selected exotic forest pests in North America... Biological invasions are probably the most significant environmental threat to the maintenance of natural forest ecosystems in North America and elsewhere. The magnitude of this problem necessitates increased efforts to reduce the incidence and impacts of pest invasions.

Keywords: chestnut blight, white pine blister rust, leaf rust, oak wilt, biogeography, pest invasion, ecosystem mgt., review

Folder: WPBR impact

Location: file

Lombard, K.; Bofinger, J. 1999. White pine blister rust, *Cronartium ribicola*, infestation incidence for selected areas of New Hampshire. Durham, NH: Department of Resources and Economic Development, NH Division of Forests and Lands.

Annotation: This study's main objective was to determine how the incidence of blister rust changed since the mid-1900s. These results are consistent with a 1960 study done by John Charlton (1963).

Keywords: white pine blister rust, eastern white pine, damage survey, id guide, pest hazard

Folder: WPBR impact

Location: file

Maloy, O.C. 1997. White pine blister rust control in North America: a case history. *Annual Review of Phytopathology*. 35:87–109.

Abstract: White pine blister rust was introduced into north America at the turn of the twentieth century, threatening valuable white pine resources. Measures to eliminate, contain, or control this disease constitute the most extensive forest disease control effort in time, money, and material in the history of US forestry. The major thrust was protection of pine stands by eliminating currant and gooseberry (*ribes*) alternate hosts from within and around these stands. Failures with *ribes* eradication resulted in application of antibiotic fungicides without adequate testing. These failures, coupled with lower dependence on white pines and reduced need for a large reserve of men for fire fighting, lead to sudden termination of the program in 1967. The chronology of events and interactions between agencies and personnel responsible for the program provide an interesting case history and, it is hoped, valuable lessons for the future.

Keywords: white pine blister rust, disease control, forest history, review

Folder: WPBR impact

Location: file, pathology

Matthews, D.N.; Blair Hutchison, S. 1948. Development of a blister rust control policy for the national forests in the Inland Empire. *Stn. Pap. 16. U.S. Forest Service, Northern Rocky Mountain Forest and Range Experiment Station*. 116 p.

Annotation: This study has been directed toward answering three questions and interpreting the answers in terms of Forest Service policy for the Inland Empire: Can blister rust be controlled?. Can blister rust be controlled a reasonable cost? Are future white pine crops worth a sizeable present expenditure? In answering these questions the report provides an interesting review of control in northern Idaho up to late 1940s, an assessment of the importance of white pine in the timber market, and the basis for policy. The authors conclude that blister rust can be controlled by *ribes* eradication, at a reasonable cost relative to the timber value of white pine at the present and for the following rotation. The authors are keen for chemical eradication methods and silviculture with prescribed fire for growing white pine. The ecological consequences of replacement of white pines with other species is unappreciated as is the importance of the genetic improvement programs.

Keywords: economics, forest management, tree valuation, western white pine

Folder: WPBR impact

Location: pathology

McDonald, G.I. 1979. Resistance of western white pine to blister rust: a foundation for integrated control. *Res. Note INT-252. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station*. 5 p.

Abstract: Low-level resistance to blister rust in alliance with other control options such as hazard mapping, *Ribes* eradication, rapid early growth of white pine, and branch-canker pruning can greatly expand the outlook for management of white pine in the west.

Keywords: white pine blister rust, disease control, silviculture, genetics program, review

Folder: WPBR impact

Location: file

McDonald, G.I.; Hoff, R.J. 1972a. Development of a control strategy for white pine blister rust. In: 2nd North American Forest Biology Workshop. 1972 July 31–Aug. 3. Corvallis, OR: Oregon State University: 13.

Abstract: Control of the white pine blister rust disease appears to be within our grasp. All we need is the effective application of our total arsenal of control measures, including 10 different kinds of resistance, alternate host eradication, pruning, possible biological control agents, and hazard mapping. Computer simulation of the disease should be an effective way to mold the arsenal into an efficient control strategy. The probability of infection for an individual tree for each year of its development is calculated by incorporation of yearly target area, weather, inoculum density, genetic structure, and other control measures into a model. The usefulness of the simulator is discussed by the presentation of preliminary results showing the integrated effects of reducing inoculum density, fungus growth rate, the needle-lesion frequency on the probability of infection of individual trees. The effect of reduced fungus growth rate on survival of trees supporting "lethal" infections is also discussed. [entire article]

Keywords: white pine blister rust, disease control

Folder: WPBR impact

McDonald, G.I.; Hoff, R.J. 2001. Blister rust: An introduced plague. In. Tomback, D.F.; S.F. Arno; and R.E. Keans, eds. Whitebark pine communities: ecology and restoration. Washington, DC: Island Press.

Folder: WPBR distribution, WPBR impact

McDonald, G.I.; Hoff, R.J.; Bingham, R.T. 1991. History and accomplishments of white pine blister rust research in the USDA Forest Service. In: Proceedings IUFRO Rusts of Pine Working Party Conference. 1989 September 18–22; Banff, Alberta. Info. Rep. NOR-X-317. Forestry Canada. Northern Forestry Centre: 45–53

Keywords: white pine blister rust, review

Folder: WPBR impact

Location: shelf

Mielke, J.L. 1943. White pine blister rust in western North America. School of Forestry Bulletin. 52. New Haven, CN: Yale Univ. 155 p.

Annotation: Origin of white pine blister rust. Introduction to North America. White pine of western North America. the rust on pine. The rust on ribes. Scouting for the rust. Early history of blister rust in the west. Spread of the rust by years (1910–1942). General aspect of spread. Disseminating agencies and spore stage involved. Possible limits of long-distance spread. Relation of weather to spread and intensification of the rust. Wavelike character of spread of the rust. Rate and direction of spread of the rust. Some relations of ribes species in the spread of the rust. Pinyon rust: its complication in spread of blister rust. Some biological factors unfavorable to development of the rust. Strains of white pine blister rust.

Keywords: western white pine, white pine blister rust, review

Folder: WPBR impact, Ribes, WPBR distribution

Location: shelf

Moir, W.S. 1924. White-pine blister rust in western Europe. Department Bulletin 1186. Washington, DC: U.S. Department of Agriculture. 32 p.

Annotation: The purpose of the study in Europe in 1919–20 was to determine how destructive the blister rust had been to American white-pine species planted abroad and what steps, if any, had been taken to combat this disease in foreign countries that would be of practical value in controlling the disease in the United States. It was found that cultivated black currants and gooseberries, especially black currants, are very abundant in Europe and popularly considers more valuable than the foreign white pines.

Keywords: white pine blister rust

Folder: WPBR impact

Location: pathology

Moss, V.D.; Wellner, C.A. 1953. Aiding blister rust control by silvicultural measures in the western white pine type. Circular 919. Washington, DC: U.S. Department of Agriculture. 32 p.

Annotation: Timber management can help control rust by hindering growth of Ribes. Clear-cutting, broadcast burning, and planting aids Ribes suppression and provides maximum yields. Discusses Ribes ecology and management with emphasis on Ribes viscosissimum, R. lacustre, R. inerme, and R. petiolare. Other Ribes are significant in some drainages.

Keywords: western white pine, white pine blister rust, disease control, silviculture, Ribes, resistance screening
Folder: Ribes, WPBR impact Location: file, pathology

Neuenschwander, L.F.; Byler, J.W.; Harvey, A.E.; McDonald, G.I. Ortiz, D.S.; Osborne, H.L.; Snyder, G.S.; Zack, A. 1999. White pine and the American West: a vanishing species—Can we save it? Gen. Tech. Rep. RMRS-98-197. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Abstract: This is the story of the decline of the magnificent western white pine.

Keywords: white pine, white pine blister rust

Folder: WPBR impact Location: file

Ostrofsky, W.D.; Rumpf, T.; Struble, D.; Bradbury, R. 1988. Incidence of white pine blister rust in Maine after 70 years of a Ribes eradication program. Plant Disease. 72:967–970.

Abstract: Effectiveness of a Ribes eradication program for control of white pine blister rust was evaluated by comparing the incidence of the disease in areas never treated for Ribes with areas from which Ribes were regularly eradicated over the past 70 years. White pine stands were sampled to determine the effect of treatment (whether or not Ribes were controlled), tree size class, and hazard rating on disease incidence. Disease incidence, as measured by the number of infected trees, is lower (3.8%) in areas treated for Ribes compared with areas with no treatment (9.1%). Rust incidence is lowest in reproduction stands, and highest in pole stands, Hazard zone ratings did not reflect disease levels. Survey results indicate that a significant reduction in the incidence of white pine blister rust on a statewide level has been achieved through the Ribes control effort.

Keywords: disease control, eastern white pine, Ribes, white pine blister rust

Folder: cbr weather, Ribes, WPBR impact Location: file

Pack, C.L. 1933. White pine blister rust, a half-billion dollar menace. Washington, DC: Charles Lathrop Pack Forestry Foundation. 14 p.

Annotation: Regarding the blister rust problem, therefore, from the viewpoints of economic significance, silvicultural importance, pathological knowledge and equipment for control, we may arrive definitely at certain conclusions. Economically we must conclude that white and sugar pine constitute a resource of outstanding value, the protection and re-creation of which is essential. Silviculturally these species are of proven value as a vital factor in forest planning and management. Our pathological knowledge of the blister rust is exhaustive and adequate, Equipment for control is limited only by lack of man power and funds, and, while these are greater, for the moment, than ever before, the battle for the preservation of these valuable species must have continued support.

Keywords: white pine blister rust

Folder: WPBR impact Location: pathology

Phelps, W.; Weber, R. 1969. Characteristics of blister rust cankers on eastern white pine. Res. Note NC-80. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 2 p.

Abstract: The growth, development and sporulation of white pine blister rust cankers were studied on eastern white pine in Wisconsin and Minnesota. Three distinct canker types were identified on the basis of physical appearance, growth rate, and sporulation. Canker growth rate and sporulation decreased as tree size or age increased, and many cankers apparently became inactive. High mortality of branch cankers was associated with older trees, heavily stocked stands, and small branch diameter.

Annotation: Growth rates varied with the same canker from year to year.

Keywords: eastern white pine, white pine blister rust, morphology

Folder: WPBR impact

Location: file

Real, L.A. 1996. Disease ecology. Ecology. 77:989.

Abstract: During its 2-yr deliberation establishing priorities in ecological research, the Ecological Society of America (ESA) Committee on a Sustainable Biosphere Initiative (SBI) identified the role of pathogens and pests in ecosystem stress as a major gap in our understanding of populations and ecosystem processes and recommended expanded research investigation the importance of pathogens in ecosystem function... The U.S. Forest Service... have highlighted the importance of incorporating ecological and evolutionary dynamics in the elucidation of disease processes and disease management practices and have called for additional research targeted at uncovering the basic ecological processes involved in disease transmission, emergence, and spread. This Special Feature of Ecology represents the proceeding of a symposium on "Disease Ecology" held in conjunction with the 1993 Annual Meeting of the ESA in Madison, Wisconsin, USA...

Annotation: How can spatial population dynamics increase our capacity for predicting the spread of infectious diseases at different spatial scales and dependent on different mechanisms of disease transmission?

Keywords: ecosystem mgt, environmental stress, epidemiology

Folder: WPBR impact, dm model

Location: file

Saho, H. 1981. Notes on the Japanese rust fungi. VII. *Peridermium yamabense* sp. nov., a pine-to-pine stem rust of white pines. Transactions of the Mycological Society of Japan. 22:27-36.

Abstract: Aeciospores of a rust on twigs of *Pinus pumila* resembling *Cronartium ribicola* were inoculated on white and hard pines. Positive results were obtained only on white pines. After inoculation, aeciospores were produced on *Pinus pumila*, *P. strobus*, *P. monticola* and *P. strobiformis*. On *P. griffithii*, *P. peuce*, and *P. pentaphylla*, definite fusiform swellings and discolorations were found. Because rust hyphae were recognized in the host cells, those pines seemed to be susceptible to the rust. Therefore, all tested white pine were positive to the rust, while *P. densiflora* and *P. thunbergii*, hard pines, were negative. The causal fungus is discussed as a new species, *Peridermium yamabense* Saho et. I Takasashi, the first known pine-to-pine rust of white pine.

Keywords: white pine blister rust

Folder: WPBR impact

Location: pathology

Schultz, J.R. 1989. Using disease resistant white pine to meet multiple resource objectives. Northern Journal of Applied Forestry. 6:38-39.

Annotation: This paper discusses the development of a silvicultural prescription using disease resistant white pine in a mature paper birch stand located in a visually sensitive recreation area.

Keywords: eastern white pine, white pine blister rust, host resistance, silviculture, visual quality

Folder: WPBR impact

Location: file

Schwandt, J.; Zack, A. 1996. White pine leave tree guidelines. Report 96-3. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Region, Forest Health Protection.

Annotation: Marking guidelines to assist in selecting reserve white pine under a variety of stand conditions and silvicultural treatments are presented.

Keywords: mgt guide, silviculture, western white pine, white pine blister rust, thinning
Folder: WPBR impact Location: file

Spaulding, P. 1911. The blister rust of white pine. Bulletin 206. Washington, DC: Bureau of Plant Industry. 88 p.

Annotation: This bulletin gives an account of a dangerous European disease of white pine, which also affects other five-needled pines and occurs on wild and cultivated currants and gooseberries. This disease has recently been widely introduced into America. ... If this disease is not become established in America, prompt action on all sides is necessary.

Keywords: white pine blister rust
Folder: WPBR impact Location: pathology

Spaulding, P. 1922. Investigations of the white-pine blister rust. Bulletin 957. Washington, DC: U.S. Department of Agriculture, Forest Service. 100 p.

Annotation: Origin and distribution of *C. ribicola*, hosts, life history, over wintering, important dates in the life history, control, literature cited are discussed. Table 1. Results of inoculation made on various species and horticultural varieties of *Ribes*, showing data on susceptibility in the greenhouse and out of doors on Block Island, RI.

Keywords: white pine blister rust, review, resistance screening, *Ribes*,
Folder: *Ribes*, WPBR impact Location: file, pathology

Spaulding, P. 1929. White-pine blister rust: a comparison of European with North American conditions. Tech. Bull. 87. Washington, DC: U.S. Department of Agriculture. 58 p.

Annotation: An investigation of the white-pine blister rust caused by *Cronartium ribicola* was made in 1922 in the various countries of northern and western Europe (Germany largely excepted).

Keywords: white pine blister rust
Folder: WPBR impact Location: pathology

Steinhoff, R.J. 1972. White pines of western North America and Central America. In: Misc. Pub. 1221. Biology of rust resistance in forest trees. Proceedings of NATO–IUFRO Advanced Study Institute. 1969 August 17–24. Moscow, ID. Washington, DC: U.S. Department of Agriculture, Forest Service: 215–232.

Abstract: Both species of foxtail pines (Subsection Balfourianae, Section Parrya, Subgenus Strobos) grow in western North America. *Pinus balouriana* has a very restricted distribution while *P. aristata* is widely distributed. Neither species is commercially important but both have high aesthetic value and may be useful for watershed protection and avalanche control.

There are six species of white pines (Section Strobos, Subgenus Strobos) native to western North America and Central America. All of these species are rather widely distributed with one or more species occurring in most of the major mountain ranges. Although any of the species may occur in pure stands, they usually are found mixed with several other coniferous species.

Three of the species, *P. ayacahuite*, *P. lambertiana*, and *P. monticola*, are commercially important and a fourth, *P. strobiformis* is harvested but on a much smaller scale. The other two species, *P. albicaulis* and *P. flexilis* are not often cut for timber but have aesthetic value and are important for watershed protection.

Numerous efforts have been made throughout the world to cross these species with other white pine. Several of the resulting hybrid combinations show promise for a variety of uses and for planting in areas where there are few or no native white pines.

Annotation: In discussion, mention is made of *P. rzedowskii* as a newly described species of Mexico which bridges Subsections Balfourianae and Cembroides. Van Arsdel indicates that outliers of *P. strobis* are usually associated with sandstone outcrops with no other competing tree species.

Keywords: white pine, distribution

Folder: WPBR impact

Location: shelf

Stewart, F.C.; Rankin, W.H. 1914. Does *Cronartium ribicola* over-winter on the currant? Bulletin 374. Geneva, NY: New York Agricultural Experiment Station. 53 p.

Annotation: Describes early history of the rust outbreak at Geneva (first in North America) Concludes that over-wintering occurs rarely, if at all.

Keywords: Ribes, white pine blister rust

Folder: Ribes, WPBR impact

Location: pathology

Tomback, D.F.; Clary, J.K.; Koehler, J.; Hoff, R.J.; Arno, S.F. 1995. The effects of blister rust on post-fire regeneration of whitebark pine: the Sundance Burn of northern Idaho (U.S.A.). Conservation Biology. 9:654–664.

Abstract: In the northern Rocky Mountains, whitebark pine (*Pinus albicaulis*) is rapidly declining as a result of previous fire exclusion policies, mountain pine beetle (*Dendroctonus ponderosae*) outbreaks, and white pine blister rust (*Cronartium ribicola*). Blister rust is potentially the most destructive agent, killing seedlings, cone-bearing branches, and, eventually, mature trees. We examined densities of whitebark pine regeneration and the incidence and severity of blister-rust infection of seedlings and saplings in the 25-year-old Sundance Burn in the Selkirk Range of northern Idaho, an area heavily infected with blister rust. We found that the mean regeneration density of whitebark pine was significantly lower than that of two other comparably aged burns in western Montana. The low density was attributed to the severe damage to the seed source on the burn perimeter, resulting from previous infestation of mountain pine beetle and blister rust. Overall, 29% of the whitebark pine regeneration in the Sundance Burn was infected by blister rust. Age and height of seedlings were important predictors of incidence of infection, and height was the most important predictor of severity of infection. Thus, as seedlings grow larger, they present a bigger target to airborne blister-rust spores. Because of the lack of seed production in the adjacent forest and expected mortality, regeneration of whitebark pine in the Sundance Burn will be slow. In areas of northern Idaho and northwestern Montana affected by blister rust and pine beetle, prescribed fires for managing whitebark pine ecosystems should be restricted to small areas or should require planting of rust-resistant seedlings.

Keywords: whitebark pine, white pine blister rust, bark beetle, fire, damage survey
Folder: WPBR impact Location: file

Tombeck, D.F.; Arno, S.F.; Keane, R.E., eds. 2001. Whitebark pine communities: Ecology and restoration. Washington DC: Island Press. 425 p.

Keywords: whitebark pine
Folder: WPBR impact

White, E.E.; Morrison, D.J.; Kinlock, B., Jr.; Westfall, R.D.; Gitzendanner, M.A.; Foord, B.M.; Dupper, G.E. 1999. Measuring shifts in forest pathogen populations. In: Lieutier, F.; Mattson, W.J.; Wagner, M.R.J. eds. Physiology and genetics of tree–phytophage interactions; 1997 August 31–September 5; Versailles, France. Victoria, BC: Canadian Forest Service, Pacific Forestry Centre.

Annotation: The genetics of trees and phytophagous organisms converge at their interactions, producing resistance or susceptibility, so that in insect or disease interactions, resistance is the product of two set of genes. ...*Cronartium ribicola*, the results showed the pathogen is heterothallic, highly outcrossing, and in genetic equilibrium. The demonstration of virtually uninhibited outcrossing has profound implications for the stability of tree resistance, because of the recombinational potential in the pathogen to generate races with multiple forms of virulence.

Keywords: Armillaria, white pine blister rust, population genetics
Folder: WPBR impact

Note: Location (if not blank) indicates where the article is held---file=office filing cabinet, mistletoe=lab mistletoe reprint collection, pathology=lab forest path collection.