Report to the Great Plains Tree Pest Council

Sterling, CO; April 9-10, 2003

Rapid City Service Center, Forest Health Management
USDA Forest Service, Rocky Mountain Region (R-2)

Staff:	Office:
Kurt Allen - Leader/Entomologist	1730 Samco Road
Jim Blodgett - Plant Pathologist	Rapid City, SD 57702
Bill Schaupp - Entomologist	Phone: (605) 394-1960
Dan Long - Forest Health Technician	FAX: (605) 394-6627
	Email: kallen@fs.fed.us

Website: www.fs.fed.us/r2/fhm

Service Area: All of South Dakota, except northwest corner; All of Nebraska; Northern Wyoming east of the Continental Divide.

Summary of Rapid City Service Center: 2002 – 2003

Coniferophagous tree-killing bark beetles again dominated the activities of the Rapid City Service Center staff in 2002. Epidemic populations of pine engraver, mountain pine, spruce, Douglas-fir, and western balsam bark beetles continued to increase dramatically within our service area. Wildfires and associated insect activity continued to generate interest in wood borers, pine engravers, and red turpentine beetles. Having at last hired a plant pathologist, Jim Blodgett, we were able to pursue a project on limber pine health in the Big Horn Mountains that featured white pine blister rust and, of course, tree-killing bark beetles. All this left little to no time for Great Plans forest pests.

Reports:

RCSC-02-06 - Marking guidelines in timber sales surrounding the Beaver Park Area, Black Hills National Forest
RCSC-02-07 - Insect activity in the Battle Creek fire area, Black Hills, South Dakota
RCSC-03-01 - Insect conditions on the Wind River and Washakie Ranger Districts, Shoshone National Forest
RCSC-03-02 - Mountain pine beetle conditions on the east face of the Shoshone National Forest and environs
RCSC-03-03 – Sick pines in the Nebraska National Forest, Bessey Ranger District
RCSC-03-04 – Aerial survey for 2002 of the Black Hills National Forest and environs
RCSC-03-05 – Aerial detection survey, Exemption Area and Fort Meade, Bureau of Land Management, South Dakota
RCSC-03-06 - *Ribes* species in the Black Hills, SD

Send to Bill & Holly

Evaluations:

Allen, K. K., Schaupp, W. C. Jr., and D. F. Long. 2002. Evaluation of mountain pine beetle activity in the Beaver Park area of the Black Hills National Forest. *USDA Forest Service, Rocky Mountain Region, Renewable Resources, Biological Evaluation* R2-03-03, 14 pg.

Allen, K. K., Schaupp, W. C. Jr., and D. F. Long. 2003. Evaluation of mountain pine beetle activity in the Deerfield area of the Black Hills National Forest. *USDA Forest Service, Rocky Mountain Region, Renewable Resources, Biological Evaluation* R2-03-04, 14 pg.

Schaupp, W. C. Jr., Allen, K. K., and D. F. Long. 2002. Evaluation of the Douglas-fir beetle along the North Fork of the Shoshone River and the Clarks Fork of the Yellowstone River, Shoshone National Forest, Wyoming. *USDA Forest Service, Rocky Mountain Region, Renewable Resources, Biological Evaluation* R2-03-02, 13 pg.

Current Work at Rapid City Service Center

Insects and Diseases:

- Subalpine fir decline in spruce-fir forest type of the north-central Rocky Mountains
- Evaluation and monitoring of direct and indirect effects of hail damage to ponderosa pine stands on the Black Hills National Forest.

Insects:

- Gypsy moth detection trapping in recreation sites of national forest and parks in South Dakota and Wyoming
- Bark beetle brood and line/transect sampling: spruce beetle, *Ips*, mountain pine beetle, Douglas-fir beetle, and western balsam bark beetle in the Black Hills, Bighorn, and Shoshone National Forests
- Interaction between fire-damaged ponderosa pine and insects
- Red turpentine beetle pheromone biology
- Using MCH to prevent Douglas-fir beetle attacks
- Ips infestations following jack pine budworm defoliation on the Bessey Ranger District, Nebraska National Forest

Diseases:

- Commandra and white pine blister rust permanent plot re-measurements
- White pine blister rust and 5-needle pine interactions in Wyoming
- Armillaria species survey of Wyoming
- Fire effects on Armillaria in Blackhills

Aerial Detection Surveys:

- Plains and riparian forests in South Dakota
  - Tribal nations and lands administered by the Bureau of Indian Affairs
  - Nebraska National Forest
  - State and private lands

Report to Great Plains Tree Pest Council

April 9-10, 2003
Sterling, Colorado

Mark Harrell and Laurie Stepanek
Nebraska Forest Service, University of Nebraska

Pine wilt

A large number of trees were killed by pine wilt in 2002, with almost 100 trees killed at one location alone near Plattsmouth. The southeastern corner of the state, generally south and east of Lincoln, is still the area where mortality is the greatest, but the disease has killed trees at several locations in areas to the north and west. The growing concern about the effect of pine wilt on Scotch and Austrian pines is causing many people to look for alternative species for windbreaks and other plantings.

A test was conducted to determine whether trunk-injection treatments could be effective in protecting trees from pine wilt. Three insecticide products had been tested in the lab for their effectiveness in killing pinewood nematodes. One product, abamectin, was able to kill or immobilize the nematodes when present in concentrations similar to what the nematodes would encounter in a treated tree. In May 2002, abamectin (Greyhound) was injected into 80 pines scattered across southeastern Nebraska and at an abandoned Christmas tree farm in northeastern Kansas. Unfortunately, the injection treatments did not protect the trees from invasion by the nematodes. Plans for 2003 are to increase the dose applied to trees and to test two different trunk injection methods. We also will be trying to determine the likelihood that pine wilt will soon become a serious problem in western and northern parts of the state by identifying potential beetle vector species in eastern and western Nebraska, checking for the presence and number nematodes they carry from pine wilt killed trees, and determining the relative degrees of pathogenicity of eastern and western populations of pinewood nematodes by artificial inoculations into young pine trees.

White pine mortality

Many eastern white pines have died suddenly in southeastern Nebraska over the past several years. This has been especially common in fall and winter, but mortality has occurred in the summer as well. The problem has occurred in urban areas and Christmas tree plantations, affecting trees from about five years old to nearly mature. Trees typically have good growth rates, but then turn brown and die within one to two months.

A survey of 16 white pine Christmas tree plantations across eastern Nebraska was conducted in 2002 for two diseases: procerum root disease caused by the fungus *Leptographium procerum* and pine wilt caused by the pinewood nematode, *Bursaphelenchus xylophilus*. Trapping of pales weevil (*Hylobius pales*), which vectors *L. procerum*, was also conducted. Neither the fungus nor the nematode was isolated from dead trees. Pales weevil was collected at one location. Other causes for white pine mortality will be investigated in 2003.

Cercospora blight control test

Cercospora blight is a serious problem in juniper and redcedar in central and eastern Nebraska. In 2002 a test of the copper fungicide Champ was continued for the second year to try to find an economical

alternative to the fungicide Camelot. Blocks of trees were sprayed twice as recommended in five windbreaks near Lexington in central Nebraska. The same trees will be treated again in the summer of 2003 and will be evaluated in the fall. In preliminary evaluations Champ does not seem to be providing much protection for the trees.

Oak wilt

Bur oaks along the southeastern edge of Nebraska over the past several years have shown symptoms that have often been diagnosed as oak wilt. The symptoms include foliage that dies completely or has large necrotic areas, branch dieback, general decline in the tree, and occasionally some streaking in the wood. Although the fungus has still not been confirmed from these trees by isolating it from samples of streaked wood, the current assumption is that oak wilt in combination with changes in site conditions is killing trees in communities and developed areas along the eastern edge of the state. In 2003 Arbor Day Farm in Nebraska City will be testing mulching, soil aeration, and injection treatments for control of the disease.

Pest Conditions

Drought: Many young trees lost. many seed sources

Pine wilt: Continued losses of Scotch pine in southeast Nebraska from pine wilt. Also observing red and jack pine dying at Horning Tree Farm--an area where disease pressure is high. Eastern white pine at Horning unaffected. is it really pine wilt?

Verticillium wilt: Mortality in maples from Verticillium wilt was very high in 2002, possibly because of stress from the drought.

Oak lace bug: Populations on bur oak were high again this year.

Bagworm: Populations were high in scattered areas of southeast Nebraska.

New publication

Harrell, M.O. Tree injections and implants. *in* Insect Pests of Midwest Landscapes, V. Krischik and J. Davidson, eds., University of Minnesota (in press).

Web sites

http://www.nfs.unl.edu/index.htm
http://www.nfs.unl.edu/fpm.htm
http://www.ianr.unl.edu/pubs/insects/index.htm
http://www.ianr.unl.edu/pubs/plantdisease/index.htm
http://www.ianr.unl.edu/pubs/forestry/index.htm

Wyoming State Forestry Division
Les Koch
Great Plains Tree Pest Council Annual Meeting
April 9th and 10th, 2003 - Sterling, Colorado

Wyoming State Forestry Division (WSFD) conducted a one million acre aerial survey of Wyoming in 2002. The survey area consisted of the North, Middle, and South Laramie Range Mountains from the Colorado/Wyoming border north to Casper; Hat Creek Breaks in Niobrara county north of Lusk, eastern Converse county, northwest Goshen county, and northeast Platte county; and Pine Ridge in northwest Converse county, northeast Natrona county, and southeast Johnson county.

Mountain pine beetle killed roughly 776 ponderosa and lodgepole pines in the Laramie Mountain Range, Hat Creek Breaks, and Pine Ridge. Most MPB activity was categorized by scattered small pockets throughout the survey area. Muddy Mountain, Casper Mountain, Davis Peak, and Warbonnet Peak in the North Laramie Mountain Range as well as Big Bear Canyon, LaBonte Canyon, and Curtis Gulch in the central Laramie Range saw large areas of beetle activity. The most concentrated activity in Hat Creek Breaks was on State property four miles north of Manville adjacent to Highway 270 in Niobrara County. A pocket of 160 trees north of Antelope Creek in Converse County represented the most active spot in Pine Ridge.

MPB mortality by county	
County	**Mortality**
Albany	252
Converse	336
Natrona	88
Platte	29
Goshen	12
Niobrara	51
Johnson	7
Laramie	1
Total	**776**

White pine blister rust is a major factor leading to the marked decline in limber pine in Wyoming. Limber pine was a major species throughout most of the survey area, especially in the North and South Laramie Mountain Ranges. Although WPBR was evident virtually throughout the entire range of limber pine in the survey area, South Laramie Range had the most decline evident: roughly 2275 trees with noticeable flagging and/or dead crowns covering over 600 acres. The majority of decline was in the Vedauwoo Recreation Area, including Turtle Rock. Three large areas measuring 740 acres of limber pine mortality were also observed: east of Pilot Hill, northwest of Buford, and west of the I-25 and Highway 210 interchange.

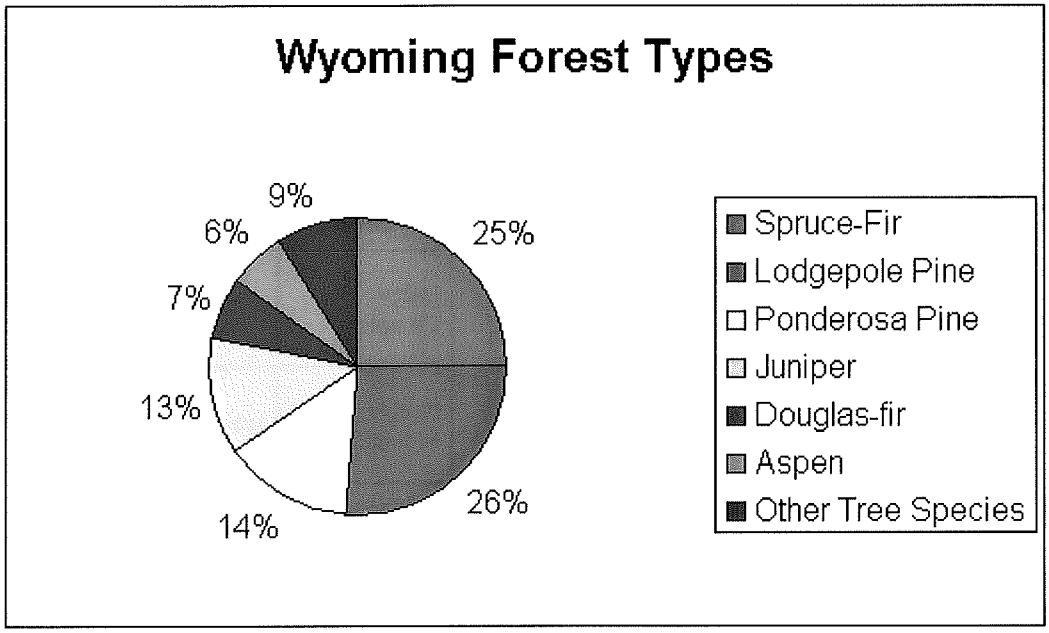
Various root rots and western balsam bark beetle work together to cause significant mortality in subalpine fir. The most mortality of subalpine fir occurred in the North Laramie Range where 1634 trees were killed. Thirty seven subalpine firs were killed in the Central Laramie Range and eight trees were killed in the South Laramie Range in the Tie City Campground.

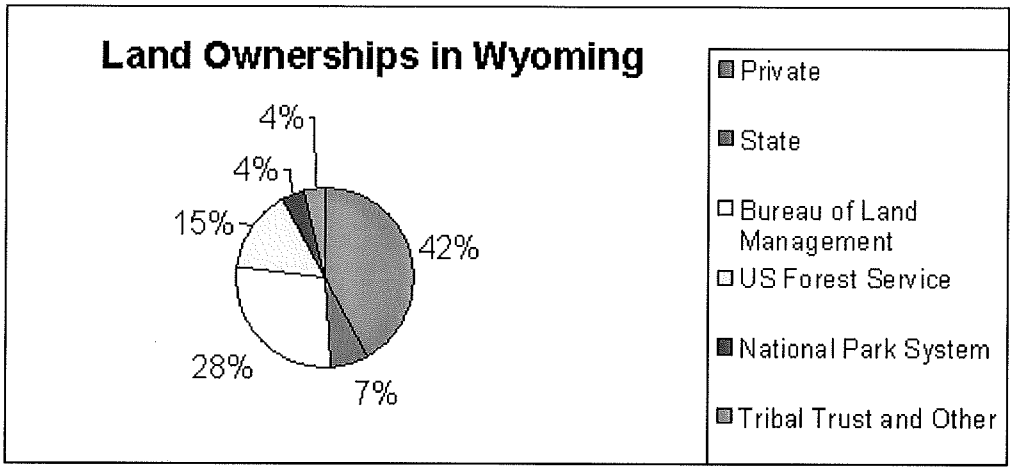
The Central Laramie Range Mountains reported two large fires during summer 2002: Hensel and Reese. Each fire measured roughly 12000 acres. The Tollman fire encompassed 5900 acres in the Hat Creek Breaks.

0 gypsy moths he caught
1 in Yellowstone

The Forest Resource

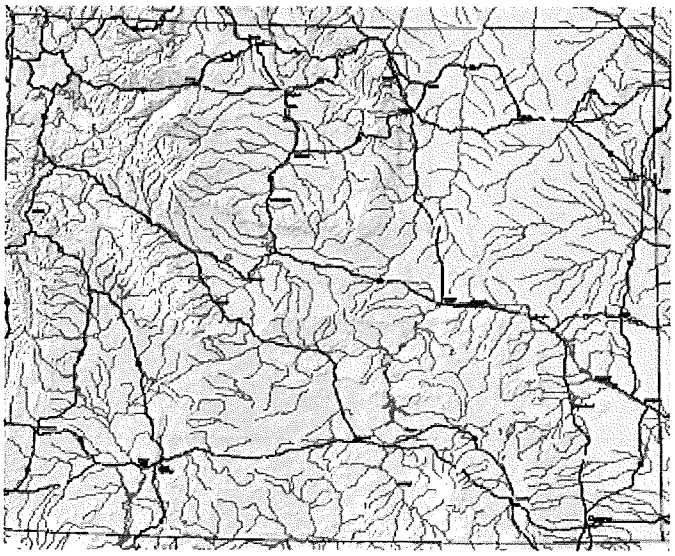
Wyoming contains 9.8 million acres of forested lands. These forests provide many valuable resources including wood fiber, recreation, tourism, wildlife and fish habitat, cattle/sheep grazing, mineral resources, and water production. Approximately 4.3 million acres are used commercially for wood fiber production. Over 17,000 forested acres were harvested in 2002. Water from forested lands provides 19,437 miles of streams and 427,219 surface acres of lakes in Wyoming.





Special Issues

Wildfires - Four years of extensive, severe drought promoted a busy wildfire season in 2002 for Wyoming. Over 270 wildfires started in Wyoming during the year and burned over 56,000 acres of forest and range lands.



Largest Wildfires - Wyoming 2002	**Location (nearby towns)**	**Dates** *Started* - *Ended*	**# of acres burned**
Daley Complex	Gillette	June 28 - July 16	37,000
Reese Mountain	Wheatland	June 29 - July 11	19,334
South Fork II	Lander	June 30 - July 20	15,000
Hensel	Wheatland	June 7 - Aug.5	14,730
Pass Creek	Lander	Aug.24 - Sept.9	13,433

Forest Health - "It's not a good time to be a conifer in WY," said an observer who was extensively traveling Wyoming's forests in 2002. In recent years, many bark beetle populations increased to outbreak and epidemic levels in these forests. The various bark beetle infestations are dramatically killing thousands of conifers throughout the forests in Wyoming. Adding to

the beetle problems are disease problems affecting limber and whitebark pines, and subalpine firs.

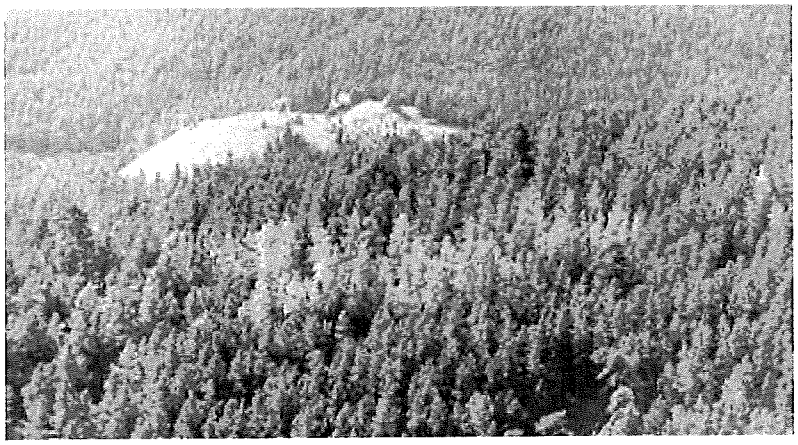
Mountain pine beetle, *Dendroctonus ponderosae*, attacks lodgepole, ponderosa, limber, and whitebark pines in Wyoming. This beetle is killing an estimated 200,000 pines in Wyoming.

Yellowstone National Park, the Bridger-Teton and Shoshone National Forests experienced thousands of whitebark pines and limber pines dying due to activities of this beetle. Mountain pine beetle, along with some forest diseases, are playing a significant role in limber pine and whitebark pine decline on over 58,000 acres of white pines in western Wyoming.

This beetle is also causing considerable damage in ponderosa pine in the lower foothills of the Bighorn Mountains from Johnson County and north into Sheridan County on state, private, and federal lands. With populations in this area of the Bighorns increasing, tree mortality caused by this beetle will be greatly visible in 2003.

Mountain pine beetle continues to infest large areas of the Wyoming side of the Black Hills. Crook and Weston Counties contained mountain pine beetle infestations with over 15,000 trees killed in this area. Populations in this area increased from 2001 to 2002 with pockets of 20-50 dead ponderosa pines common in north-eastern Wyoming.

Small pockets of dead lodgepole and ponderosa pines, killed by mountain pine beetle, were characteristic in the Laramie Mountain, Sierra Madre, and Snowy Mountain Ranges of south-central and south-eastern Wyoming. Many of these pockets contained over 150 dead trees.



Mountain pine beetle infestations along the eastern foothills of the Bighorn Mountains.

Spruce beetle, *Dendroctonus rufipennis*, attacked hundreds of Englemann spruce in Wyoming. In the Bighorn Mountains, Shell Reservoir and Ten Sleep Canyon areas are experiencing epidemic levels of spruce beetle. Following small blowdown events in 1997-1999, spruce beetle populations are increasing in the Sierra Madre and Snowy Mountain Ranges of the Medicine Bow National Forest. Several large spruce beetle infestations were detected along stream bottoms in the Sierra Madre mountain range.

Large pockets of spruce tree mortality caused by this beetle were observed in Yellowstone

National Park east of Yellowstone Lake and in the Teton and Absaroka Mountain Wilderness Areas in western Wyoming. These infestations started in the wilderness areas and national park, and now have moved out to impact large areas of state, BLM and other national forest lands. Spruce beetle populations increased in the Wind River Range, partly in conjunction with fires that occurred in the area over the past few years.

Spruce beetle mortality on the Shoshone National Forest.

Douglas-fir bark beetle, *Dendroctonus pseudotsugae*, kills large Douglas-fir trees and is causing extensive damage in Wyoming forests. Douglas-fir beetle infestations frequently result from disturbance events that create large volumes of weakened Douglas-fir trees in the vicinity of susceptible stands. In 1988, extensive wildfires occurred in Yellowstone National Park and the Shoshone National Forest. Populations of Douglas-fir beetle increased in the fire-scorched trees. Subsequent generations of the beetles moved from these injured trees to undamaged trees in nearby forest stands (Schaupp et. al 2002).

Significant Douglas-fir mortality is occuring throuout river corridors in western Wyoming. There was an increase in Douglas-fir beetle activity during 2002 with over 11,000 trees killed alond the Snake River and Greys River on the Bridger-Teton National Forest. Significant mortality is also occurring throughout the North and South Forks of the Shoshone River. Impacts are being felt as trees die in campgrounds and around summer cabins and resorts and these scenic corridors are impacted. There is also a growing concern over fire hazard with the accumulation of dead trees in these areas. Douglas-fir beetle is also on the increase on the southern end of the Shoshone near Dubois. In all of these areas, the beetle populations are expected to rise and cause even more mortality in the coming year. Suppression and control efforts to minimize impacts to these high value recreation areas are ongoing on both the Shoshone and Bridger-Teton National Forests.

The west and east fronts of the Bighorn Mountains are experiencing outbreaks of Douglas-fir beetle. On the west side populations have significantly increased in both Shell and Tensleep Canyons. These areas are expected to contiunue to suffer further mortality in 2003.

Douglas-fir beetle infestations along the North Fork of the Shoshone River.

White pine blister rust disease, caused by the fungus, *Cronartium ribicola*, infects Wyoming's white pines (limber and whitebark) and Ribes plants (currants and gooseberries).

White pine blister rust ranges from low to severe infection levels in whitebark and limber pine stands throughout Wyoming forests. Some stands have high disease levels with more than 60% of the trees infected and dying due to the rust. Forest Service aerial surveys show white pine blister rust, along with other damaging agents of mountain pine beetle, dwarf mistletoe disease, and needle blights damaged more than 46,000 acres of white pine in northern Wyoming.

White pine blister rust caused marked decline in limber pines in the Laramie, Pole, and Snowy Mountain Ranges in south-central and south-eastern Wyoming. Limber pine is a major tree species throughout this area, often growing on harsh sites where no other tree vegetation can grow. Extensive studies and monitoring are ongoing in all of these white pines sites to better understand this disease and its impact in Wyoming.

Rust disease blisters on whitebark pine.

Subalpine fir decline, caused by the Western balsam bark beetle *Dryocoetes* confuses, and root rotting diseases such as *Armillaria ostoyae*, has been a serious forest health concern of forest managers working with subalpine fir sites in Wyoming.

There has been an outbreak of Dryocoetes continuing in the northern Bighorns causing subalpine fir decline for over 5 years. Much of the outbreak has been associated with

blowdown events that occurred in the middle 1990's. This outbreak appears to be going down slightly because much of the suitable host material has been destroyed.

Many stands of subalpine fir are declining on private and state properties in central Wyoming, particularly on Casper Mountain in Natrona county. In 2002 aerial detection surveys, most of the mortality of subalpine fir occurred in the North Laramie Range where over 1600 trees were killed. Large pockets of subalpine fir are declining on Little and Pine Mountains south of Rock Springs, and in the Medicine Bow and Sierra Madre Mountains in Wyoming.

Insect and disease agents continue to cause significant subalpine fir mortality on the Bridger-Teton and Shoshone National Forests. Recently, over 57,000 trees were killed on the Bridger-Teton National forest and over 19,000 on the Shoshone National Forest.

Other Insects, Diseases, and Abiotic Damages of Concern and Monitoring in Wyoming:
Western spruce budworm
Pine engraver beetle
Gypsy moth
Dwarf mistletoes
Root Diseases
Comandra blister rust and Western gall rust diseases
Needlecast and needle blight diseases
Strong wind and blow-down damages
Fire and drought damages

For Forest Health Assistance in Wyoming:

Covering State and Private lands throughout Wyoming - Wyoming State Forestry Division
Les Koch (Cheyenne, WY office)
Ph: 307/777-7586 lkoch@state.wy.us

Updated: February 2003

Forest Health Highlights home page | General Regional Highlights
Forest Health Monitoring home page

Report to the Great Plains Tree Pest Council
Sterling, Colorado
April 9-10, 2003

North Dakota Forest Health Highlights 2002

Compiled by:
Michael Kangas, Forest Health Specialist, North Dakota Forest Service

Forest Health Specialist In North Dakota

Through a cooperative agreement with the North Dakota State University, Department of Plant Pathology and the North Dakota Forest Service, a Forest Health Specialist has been funded for North Dakota. The Forest Health Specialist will be responsible for providing educational outreach, delivering training, technical assistance, and insect and disease survey efforts. Specific efforts include:

- Conducting statewide insect and disease surveys
- Performing a statewide Gypsy moth detection program that involves numerous state and federal agencies. The program enables the state to respond at the earliest stage if an outbreak should occur.
- Hosting a series of training sessions for local community foresters, arborists and landowners. Training increases the level of awareness and knowledge of potentially harmful insects and diseases. Trained cooperators provide a statewide support network and are essential for early detection and proper diagnoses of developing forest pest outbreaks.
- Providing "Pest Updates" on the North Dakota Tree Information website, preparing statewide news releases and creating or updating NDSU Extension Circulars relating to Forest Pest Management.
- Facilitate the federal Forest Health Monitoring and Forest Health Protection programs within the state of North Dakota.

2002 Insect and Disease Highlights

Gypsy Moth – *Lymantria dispar* (non-native)
Detection surveys are conducted each year in North Dakota for the Gypsy Moth. No gypsy moths were captured in 2002.

Dutch Elm Disease – *Ophiostoma ulmi* (non-native)
Dutch Elm Disease consistently causes elm mortality in urban and rural areas. This disease is a particular problem in riparian woodlands where American elm is a dominant species.

Yellow-headed spruce sawfly – *Pikonema alaskensis*
All native and introduced species of spruce (*Picea* sp.) are susceptible to the yellow-headed spruce sawfly. Every year small to medium sized spruce trees are lost to this insect. The sawfly has caused significant problems in the north-central and north-east parts of the state over the past two years.

Sphaeropsis (Diplodia) blight - *Sphaeropsis sapinea*
Sphaeropsis sapinea continues to cause problems in ponderosa pine windbreaks at the Towner State Nursery. The incidence and severity of the disease has gradually increased over a 15-year period. Drought conditions in 2002 and expected drought conditions for 2003 suggest that this disease will continue to cause problems. The disease began to appear in nursery windbreaks in the mid-1980's. The incidence and severity of the disease has gradually increased over a 15-year period. Several ponderosa pine windbreaks have been removed.

Forest Tent Caterpillar – *Malacosoma disstria*
Defoliation by the forest tent caterpillar increased from 3,045 acres in 2001 to 4,345 acres in 2002 for the Turtle Mountains of north central North Dakota.
~ w 200,000 ac total

Ash Decline
A multitude of maladies has resulted in Ash decline throughout the state. Common pests of Ash include: Anthracnose (*Gloeosporium aridum*), ash plant bug (*Tropidosteptes amoenus*), ash fomes (*Perenniporia fraxinophila*), ash borer (*Podosesia syringae*), and ash bark beetles (*Hylesinus* sp.).

Ash Fomes
This stem rot of ash has been reported in bottomland forests along the Missouri River and in the Little Missouri Grasslands area.

Riparian Forest Health
Riparian forest health continues to be an issue in North Dakota. Dutch Elm Disease and summer flooding in the lower Red River basin has contributed to forest decline within these areas. In the western half of the state, Cottonwood decline persists due to over-maturity and lack of flooding to promote cottonwood regeneration.

Drought
Severe drought throughout the western half of the state will weaken trees and make them more susceptible to insects and diseases.

Chemical damage
Herbicide damage to windbreaks and other tree plantings continues to cause problems throughout the state.

Forest and Shade Tree Disease Studies
Spring 2003

Bill Jacobi, Ronda Koski, Graduate Students: Sheryl Costello, Sam Harrison and Holly Kearns
Department of Bioagricultural Sciences and Pest Management
Colorado State University, Fort Collins CO 80523
970-491-6927 FAX 970-491-3862
william.jacobi@colostate.edu, rkoski@lamar.colostate.edu

Shade Tree Disease Studies:

1. Continued a fifth season of monitoring tree growth, tree water potentials, soil moisture, under three irrigation treatments at the Tree and Turf Research Facility.
2. Continued a study of water potential and health of old growth cottonwoods along the Highline canal in Denver CO.

Results:

1. **Tree and turf growth:**

- Tree water potentials of green ash and honeylocusts were significantly affected by irrigation amounts. Water potentials of trees in low irrigation areas differed from moderate (80% Et) and high (160% Et) irrigation amounts.
- Tree growth is greater for the high rate but not for 40 and 80% Et rates.

2. **Wood chip mulch**: A manuscript by Koski and Jacobi on this project has been submitted to the Journal of Arboriculture. We also are interested in cooperating with others to study the risk potential for invasive pests in wood chip mulch from pallets and other foreign wood products.

3. **Thyronectria and Cytospora canker resistance** is being assessed in green ash and honeylocusts grown under the irrigation treatments at the Tree and Turf research facility.

4. **Wisconsin elm hybrids**: No new work accomplished on these Hybrids from the Wisconsin breeding program.

5. **High line Canal Cottonwoods:** We are studying the water status of cottonwoods via water potentials, soil moisture using neutron probes and observation wells, along a 100 yr.-old irrigation canal that runs through metropolitan Denver. When water potentials are less than -0.3 MPa trees start to be stressed. Trees recover or reduce water stress 24 hr after water is added to the canal, but we do not know how long this recovery lasts. We do not know how long water needs to be present to relieve drought stress in mid summer. It appears that soil moisture > 20% will keep trees non-stressed (> -0.3 MPa) and soil moisture less than 10% will allow leaf water potential to decrease below -0.30 MPa. Precipitation events of 1 inch or more increases leaf water potentials but the response is short lived and an increase in soil moisture was not noted. In 2002 we are seeing record negative water potential readings in these cottonwoods since the trees did not receive any water in 2002 and the winter of 2001-2002 was very dry. We assume we will see significant dieback and death of these trees. Defoliation and dieback occurred this summer on some trees and fewer and smaller leaf size is the norm for most trees along the canal.

Plans for 2003 Shade Tree Disease Studies:

1. Continue mulch and canker studies at the tree and turf research site. However, the irrigation-tree study is at risk since I have not been able to find funding.
2. The impact of NaCl and MgCl on woody plants in Colorado is still a research question but we did not get the big CDOT funding like we hoped.
4. Continue High Line Canal cottonwood study.

Forest Tree Insect/Disease Studies

1. **Armillaria Root Disease:** We finished working on spatial relationships of **Armillaria root disease** and site features in the Black Hills of SD. We have two manuscripts –one accepted and one in review.

2. **Black stain root disease on pinyon pine**: Kearns and Jacobi have two papers in various stages of preparation. We hope the large spatial study with Sam Harrison wrapped up this year.

3. **White Pine Blister Rust**: We (Kearns, Koski and Jacobi) are developing a hazard-rating model for white pine blister rust on white pine populations in the Central Rocky Mountain Region. Plots (350) were established on federal lands throughout southeastern Wyoming in the summer of 2002 to assess the distribution, intensity, and severity of white pine blister rust. Large-scale Ribes plots were also established to evaluate the distribution and density of the alternate host. WPBR was noted on 14 % of the trees, bark beetles were noted on 0.7 % of the sampled trees and bark beetles affected only 1.3% of the rust infected trees.

4. **Ponderosa Pine Wood Borers:** Jose Negron at the Rocky Mt Station is funding Sheryl Costello to look at the best trap design and attractants to monitor wood borers in fire damaged ponderosa pine in the Black Hills.

Plans for 2003 Forest Insect/Tree Disease Studies:

1. Publish two papers on landscape scale distribution of Armillaria root disease on ponderosa pine in the Black Hills.

2. Complete Sam Harrison's thesis and wrap up the landscape scale research project on black stain root disease of pinyon pines. Publish two papers on the small-scale ecosystem impact of the disease section of this project.

3. Continue to facilitate coordination of folks working on white pine blister rust on five needle pines of the Central Rocky Mountains.

4. Continue to develop a preliminary hazard model of white pine blister rust to five needle pines in Colorado. Fieldwork in 2003 will be focused on determining where the rust front is in Colorado, Ribes species and their distribution in Colorado, obtaining additional incidence data near reliable meteorological stations.

5. Help with the wood borer study in the Black Hills

Publications:

Bishop, R. J., and Jacobi, W. R. 2002. Insects associated with black stain root disease centers in pinyon pine stands. Southwestern Entomologists. In press

Jacobi, W. R., Geils, B. W. and Taylor, J. E. 2002. Frequency of comandra blister rust infection episodes on lodgepole pine. USDA Forest Service, Rocky Mountain Research Station. RMRS RP-36:13 p.

W.R. Jacobi, S. Zeglen$_2$, J.A. Muir, R. S. Hunt. 2002. Black Stain Root Disease Mortality Rates on Douglas-fir in Coastal British Columbia. In: Proceedings of the 50th Annual Western International Forest Disease Work Conference. (Abstr.)

Holly S. J. Kearns, William R. Jacobi, and Jeri Lyn Harris·. 2002. The Distribution of White Pine Blister Rust in Southeast Wyoming In: Proceedings of the 50th Annual Western International Forest Disease Work Conference. (Abstr.)

Geils, B.W., Conklin, D., Frank, K., Guyon, J., Harris, J. L., Hoffman, J., Jacobi, W., Kearns, H., Newcomb, M., Smith, E., Van Arsdel, E., and D. Vogler. 2002. New Information on the Distribution of White Pine Blister Rust for 2002., Proceedings of the 50th Western International Forest Disease Work Conference. (Abstr.)

Smith, E.L.; Geils, B.W.; Kearns, H.S.; and W.R. Jacobi. 2002. The biogeography of blister rust invasions: the challenges of new outbreaks. 2002 Ecological Society of America Annual Meeting; Symposium on "The Rapid Decline of White Pine Ecosystems of the West: Causes, Consequences, and Restoration Strategies"; August 5-9, 2002, Tucson, AZ. (Abstr.)

Kearns, H.S.J. and W.R. Jacobi. 2002. Final report on the small scale analysis of the impact of black stain root disease centers in pinyon pine. In: Jacobi, W.R. (ed.), Final report for cooperative agreement number RMS-98103and cost share agreement number 00-CS-11020000-026. Unpublished report delivered to USDA Forest Service, Rocky Mountain Region, Colorado State University, Fort Collins, CO: p 1-110.

Report to the Great Plains Tree Pest Council

April 2003

Sterling, Colorado

Colorado State Forest Service

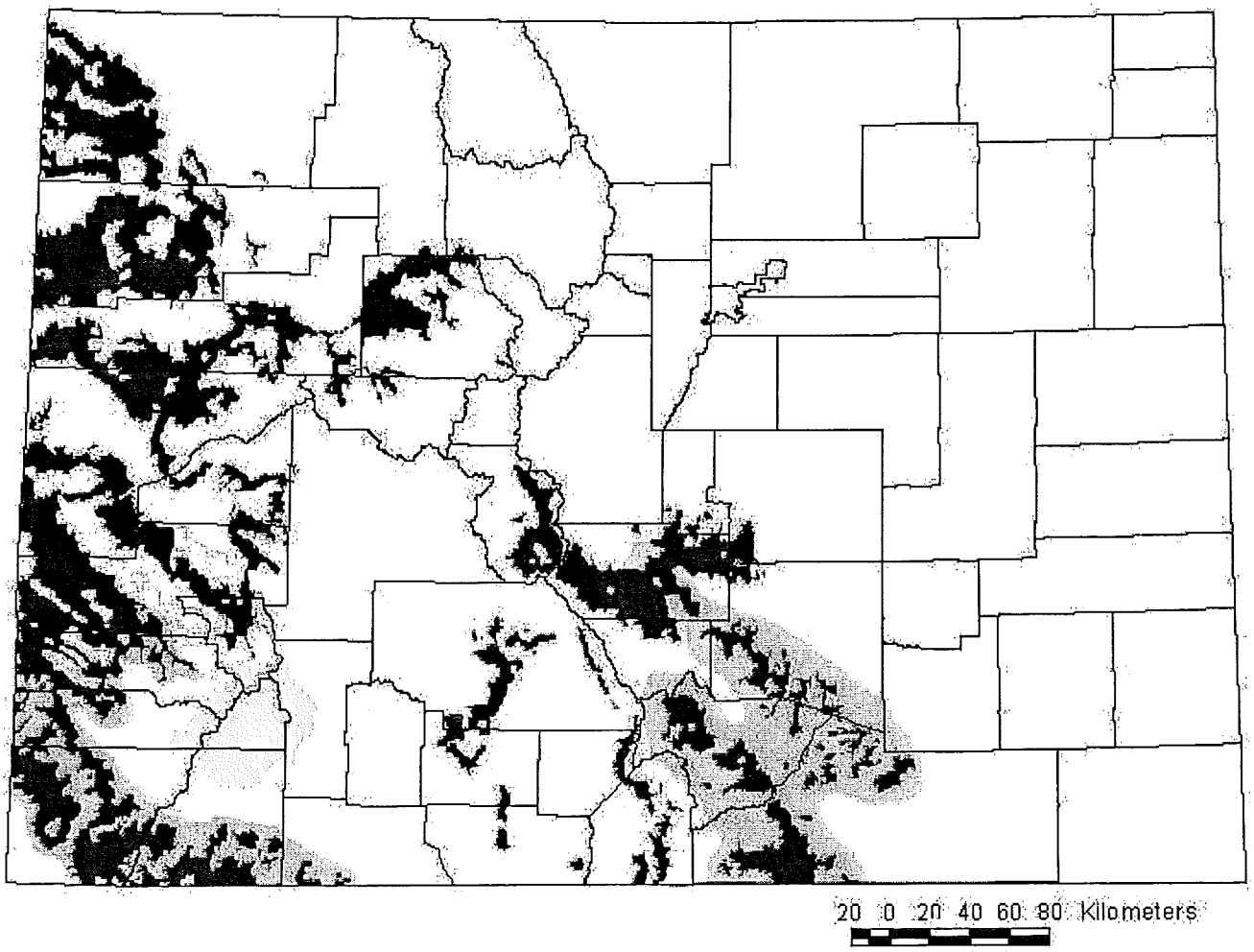
Pinyon Ips Beetle (*Ips confusus*)

This beetle is typical of the other 10 Colorado members of its genus in that it is only moderately aggressive and requires some predisposing factor in order to reach outbreak levels. At present our drought apparently has provided all the set-up it needs and the insect is operating at population levels not seen in Colorado for decades. Fire suppression has no doubt also contributed to the problem in the form of stands that are much denser than the historical norm. Such density no doubt also contributes to general stress. This beetle is thought to have four generations per year, with beetles actively flying from as early as March to as late as early November. It is basically restricted to pinyon pine (*Pinus edulis*), but may attack pines of other species growing near areas of extensive pinyon mortality that produce lots of beetles.

Mortality from pinyon ips beetles increased dramatically during 2002. The main areas of concentration include **the southern Front Range (from Colorado Springs south to Trinidad and east to Kim and west to Stonewall), and the southwestern corner (from Pagosa Springs west through Durango to Four Corners and north to Norwood)** Other areas of the state supporting a pinyon resource report significant pinyon ips mortality but at lesser levels than the previous two. Colorado's portion of the pinyon ips phenomenon is but the "tip of the iceberg", with the majority of mortality being reported from Arizona and New Mexico. In Colorado, the number of trees showing red crowns (dead trees still harboring the beetles or from which the beetles have already flown) is estimated to be in the few millions. It is not possible to estimate the number of green-infested trees, but certainly these would add considerably to the total. In the 4 Corners area of Montezuma County and parts of neighboring LaPlata, Dolores, and San Miguel Counties, visual surveys estimate about 50% of the pinyon resource is already dead.

This year's aerial surveys did not do a good job of capturing the situation for a number of reasons. Crown discoloration of dead trees increased rapidly in late summer and fall this year, which is after most of the aerial surveying is done. Even if the trees are red at the time of the flight, pinyon faders do not show up well from the air (1000 feet above tree tops is the recommended altitude for such flights) and I was shocked to see how

Areas Impacted By Pinyon Ips - Colorado - 2002



"invisible" they were when I flew areas I had ground-checked the day before and knew ips was there. I think there are two explanations for this: the tree crowns are not particularly large, and many of the soils on which they grow are reddish. These factors make the trees tough to see from both a size and blend-into-the-background standpoint. I suppose another factor is that we do not normally pay particular attention to pinyon-juniper habitats because of their low value compared to other forest types.

Management of Pinyon Ips:

Basically all prudent actions fall into the category of alleviating stress. At the landscape level, pray for rain. Once normal rains return [need to find out what this is from weather data], the ips problem should subside within a few years. At the stand level, reintroduction of fire and/or mechanical thinning would probably be the best ways to return stocking to historical levels. Thinning should be done in such a way as to not create large amounts of green slash near standing trees. Such a scenario could lead to a build-up of beetles in the downed material that spreads to the standing trees. If large amounts of slash must be created and left on the site, it should either be chipped or lopped and scattered to either physically destroy brood development or prevent it through rapid drying of the phloem, respectively. At the individual property owner level, options include preventive spraying of high-value, uninfested trees with either carbaryl or permethrin twice a year in late March and August. Due to the sheer number of infested trees, there is probably little that can be done in the way of treating infested trees prior to beetle emergence in an attempt to reduce local populations. In the case of a limited number of infested trees (a few dozen at most within a mile of the concern area), there may be some merit and chance for success in treating such trees with traditional direct control techniques (removing to a safe site, burning in the fireplace or outdoors under permit, chipping, debarking, and burying. Currently there is no registered pesticide for spraying logs infested by bark beetles. Dead and overly-dense live trees should be cleared away from the defensible space around homesites per standard d-space guidelines. Dead trees outside the d-space should probably be left for use by birds and other wildlife species dependant on snags and cavities. Also, talk nicely to your junipers.

Mountain Pine Beetle (*Dendroctonus ponderosae*)

Historically, this bark beetle is a primary mortality agent of old, slow-growing ponderosa, lodgepole, and limber pines in Colorado. The final tally from the 2002 aerial survey was 349,469 trees on 209,000 acres. This is down slightly from last year but the real total statewide is probably comparable to that of 2001 since not all areas were surveyed in 2002.

Worst hit areas continue to be:

Ponderosa Pine
Upper Arkansas Valley (from western South Park west to Buena Vista north to Granite and south to Poncha Springs/lower Monarch Pass)

Upper Poudre Canyon (from Rustic south to Pingree Park west to Poudre Falls and north to Redfeather Lakes)
US285 corridor (from Mt. Vernon Canyon west to Grant, including the towns of Conifer, Evergreen, and Bailey)
Wet Mountains (from Colorado City north to Beulah)
Dallas Divide (from Ridgway to Placerville)
Durango area (north to Rockport and e to Piedra)*

*** this bark beetle mortality is probably caused by a complex of beetles, including the MPB, Western Pine Beetle (*Dendroctonus brevicomis*), and Roundheaded Pine Beetle (*Dendroctonus adjunctus*)**

Lodgepole Pine
Vail area (I-70 corridor from w side of Vail Pass w to Eagle and s to Minturn)
Granby area (
North of Steamboat Springs (Clark to Steamboat Lake)
Rand area (w to Muddy Pass through Rabbit Ears Range)
Medicine Bow Mountains (e of Cowdry)
Twin Lakes area (w of Leadville)

Management of Mountain Pine Beetle

Fire suppression has created more homogenous pine-forested landscapes than occurred historically. Heavy human use of the pine zones and the associated issues involving life and safety probably preclude letting wildfire burn naturally from this time forward. The proper introduction of prescribed fire would partially return pine forests to a diverse condition that would preclude widespread simultaneous MPB outbreaks with the potential to kill a large percentage of the stems greater than 8 inches in diameter. Because prescribed fire cannot be applied to the majority of the resource at risk to MPB attack, forest management in the form of thinning is often used as a supplemental action. Current pine forest densities are in the range of 120 to 150 square feet or more of basal area per acre. Prescriptions to reduce the susceptibility of pine stands to MPB usually call for basal areas in the range of 60 to 80 square feet per acre. Thus, current stands on average are about twice as dense as would be desirable to minimize losses to MPB. It should be pointed out that stand treatments designed to reduce susceptibility to MPB would also have dual value by virtue of also reducing fire risk.

Prevention of attack on individual trees is in the form of annual spraying of either carbaryl or permethrin prior to the normal flight time of the beetle, which is mid-July through early September. Currently more than 120,000 high-value trees near homes or in recreational areas are being treated by this method.

Treatment of infested trees in ways that kill the beetles before they can fly to kill other trees are limited in their application to high value areas with a limited number of trees requiring attention. Methods involve solar treatments requiring 6-8 weeks of exposure to warm season temperatures, removal of infested logs to "safe sites" (defined as those more

than a mile from susceptible trees), debarking, burial, and burning. No chemicals are currently available for treatment of infested logs. The latter is a much-needed tool and should be addressed by research.

Spruce Beetle (*Dendroctonus rufipennis*)

An insect which occurs in widespread outbreaks at intervals of a few hundred years, spruce beetle is now poised to turn over Engelmann spruce forests across wide expanses of Colorado's alpine region. Epidemics usually begin with some sort of wind event which places numbers of large-diameter stems on the ground. Beetles build up in the blown down material and spread to standing trees nearby. This is exactly what has occurred in the Routt Divide area north of Steamboat Springs. The wind event was in October 1997 and involved 13,000 acres of forest. Spruce beetle estimates from aerial surveys in 2001 placed the number of infested trees at 16,474 trees on 8,827 acres. The 2002 survey found 211,255 trees on 53,349 but spruce beetle is notoriously difficult to detect with aerial survey. This year's aerial assessment is now thought to be a gross underestimate of the problem and estimates for 2003 are in the few millions of trees (source: personal communication with Andy Cadenhead, Routt Divide Blowdown ID Team Leader).

The **Routt Divide** spruce beetle outbreak now involves trees as far west as the Elkhead Mountains nne of Craig, extends north to the Wyoming border, and east to the eastern edge of the Mt. Zirkel Wilderness (all Routt National Forest). This outbreak has the potential to spread east to the Cameron Pass area and south into central Colorado, including the White River NF area which sustained a very large spruce beetle outbreak in the 1940's.

It is now apparent that the wind event of fall 1997 was by no means the only area where conditions were right for spruce beetle expansion. Small infestations are growing at scattered locations throughout the high-elevation forests of Colorado as far south as the San Juan Mountains north of Durango. A major assessment of Colorado forest risk of spruce beetle infestation was done by the USFS in the 1990's and this report in essence predicted what is becoming reality – much of the spruce resource is old and vulnerable to bark beetle attack.

Also of interest during 2002 was the number of fires burning in the spruce type. Fires are not common at the associated elevations, and the occurrence of both a spruce beetle outbreak and major fires such as occurred with the Mount Zirkel Fire Complex is quite rare in modern Colorado history.

The influence of drought and abnormally mild winter conditions extends to the upper elevations of the Colorado mountains. Spruce beetle normally requires two years to complete its life cycle. Field investigations by the USFS have determined that an unknown % of the population is completing development within one year, thus increasing the rate at which the population expands.

Management of Spruce Beetle
While no silvicultural systems have proven effective to prevent outbreaks of spruce beetle, harvesting schedules that promote the widespread existence of an uneven-aged condition typical of Engelmann spruce should preclude widespread spruce beetle mortality.

Spruce beetle normally favors the undersides of old, large-diameter trees that are either lying prostrate in the shade of standing trees, or old, large-diameter (greater than 16 inches dbh) trees growing in riparian areas, and in stands that are made up of more than 65% spruce. Rapid and thorough salvage of fresh blown down stems has proven effective in slowing or preventing population build-ups. An anti-aggregating pheromone called MCH has been applied to freshly downed material and rendered it virtually unattractive to the beetles. It utility is limited to the time period immediately following creation of the downed trees. Another techniques proven effective, if utilized properly, includes the cutting of "trap trees" (usually at the rate of 1 trap tree per 2-6 infested trees), which are green trees of susceptible diameter felled near an infestation area. The idea is to attract beetles into the cut logs (sometimes aggregating pheromones are used to enhance the attraction inherent in fresh-cut logs) and then these stems are removed from the area in timely fashion, eliminating an appreciable percentage of the local beetle population. A variation on this theme is the "lethal trap tree" method, which involves treating the cut, green trees with insecticide. This method kills the beetles on site and would be applicable to areas where timely salvage is not possible

Individual, high-value, live trees can be protected with preventive sprays that treat the lower 40 feet of the stem with carbaryl or permethrin on an annual basis. This may be the only way to retain large-diameter spruce in recreation or residential areas near large outbreaks.

Ips spp. (other than *Ips confusus* in pinyon pine)

Colorado has 11 total species in this genus. All are relatively unaggressive bark beetles that attack stressed pines or spruce.

Three species colonize spruce. The so-called "spruce ips" (*Ips pilifrons*) is notable in that it colonizes the tops of the same logs attacked on the sides and bottom by spruce beetle (*Dendroctonus rufipennis*). This illustrates well the normal niches of these two bark beetle genera. The ips beetle is able to cope with the hotter, drier habitat of the log top, while the bigger, aggressive species requires moisture conditions comparable to a living, standing tree (which it later moves to as its second choice when the freshly-downed, shaded log habitat is depleted).

The so-called "blue spruce ips" (*Ips hunteri*) is found throughout the native and most of the planted range of its host in Colorado. In native forests it has never been considered a problem (or perhaps its damage has been lumped in with, or mistaken for, that of spruce

beetle). In urban habitats we now have a mature Colorado blue spruce resource (75+ years old) that is vulnerable to the stresses of urban life and the additional burden of a regionwide drought. Blue spruce ips is now considered a significant problem in many cities, including Fort Collins, Greeley, Denver and Colorado Springs. For example, approximately 45 large, infested Colorado blue spruce were condemned by the City of Fort Collins Forestry Department in 2001. Dozens of very valuable blue spruce succumbed to blue spruce ips in the Broadmoor Hotel neighborhood of Colorado Springs. Greeley and Denver, the first two cities where this problem was reported in the early 1990's continue to report significant losses.

The species in pine (most notably *Ips pini*, *I. knausi,* and *I. calligraphus*) are not normally more than annoying collateral associates of the mountain pine beetle. However, in the stress-inducing environment of a drought, ips beetles are doing to ponderosa pine and lodgepole pine somewhat the same thing as the pinyon ips is doing to pinyon. However, the differences would be that in the case of the non-pinyon species, the damage has not been as widespread and as sudden. Also, the non-pinyon species seem to be working in concert with dwarf mistletoe in addition to drought. This threesome of factors has resulted in the death of tens of thousands of trees from the middle elevations of the mountains down onto the plateaus on the West Slope and down onto the plains in the East. The exact figure is difficult to estimate because of the widespread nature of the damage and the impossibility of separating this from mountain pine beetle mortality during aerial surveys. Pines dying of ips in combination with mistletoe and/or drought tend to die in stages, with individual branch systems dying or the top of the tree dying first, followed by more and more of the crown, until over the course of 1-3 years, the whole tree dies.

Another major issue with ips beetles is their tendency to attack greenwood created during fire mitigation efforts or general forest thinning operations. With the fire season of 2002, there has been a great surge in both public funding and public acceptance of such efforts. Ever-increasing quantities of "slash" are being created, and unless this material is created and managed correctly, very real potential exists for ips build-ups that could spread to standing trees nearby. These standing trees are the very trees saved from the saw for their various values on the landscape. CSFS created a fact sheet in fall 2002 intended to provide guidance to foresters and the public on this issue, but much more education is needed.

Balsam Bark Beetle (*Dryocoetes confusus*)

This bark beetle has been working together with various root disease pathogens such as *Armillaria* spp. and annosum root disease (*Heterobasidion annosum*) to result in the mortality of millions of subalpine firs at higher elevations over the last half-decade. Together this condition is known as "Subalpine Fir Decline". During the 2001 aerial surveys, 712,427 trees on 258,751 acres were recorded. Results of the 2002 surveys are being totaled but are expected to show similar or even greater levels. As such, this constitutes the single greatest mortality factor for which we have fairly firm figures.

Because these losses occur largely outside human development areas, they do not generate significant public outcry. The only locations where this complex of organisms commonly impacts human development is near and within ski areas. It is yet another natural response to the abnormally mild, low snow-pack years in recent years and serves to indicate that the impact of the drought, indeed, extends to our highest elevations.

Douglas-fir Beetle (*Dendroctonus pseudotsugae*)

Presently this beetle is not as serious levels in general. A total of 6,747 trees were detected during 2001 aerial surveys, with results from 2002 not yet available. This is one of the few members of its genus which has a clear tendency to attack large-diameter Douglas-fir stems scorched-but-not-killed-by fire. With the large acreage of fires that occurred during 2002 in the ponderosa pine/Douglas-fir forest types, this is an insect to anticipate there in damaged Douglas-firs over the next few years (Hayman, Schoonover, Black Mountain, James John, Iron Mountain, Coal Seam, etc., for example).

Other Issues

Presumably because of the drought and associated shortage of woody plant food items, a much greater incidence of damage by certain tree-feeding animals was reported in 2002. For example, reports of phloem-feeding (i.e. debarking) on limbs and boles of pines and other trees by porcupines were up. This seemed to be particularly the case for the Black Forest region of Douglas, Elbert, and El Paso Counties.

Likewise, mule deer browsing on seedlings and gnawing of trunk bark by other large ungulates such as deer, elk, and moose was up. While not directly impacting trees all that much, the notorious, widely-publicized migration of black bears to low elevations or residential areas within the mountains traces its origins to the same environmental cause – lack of water. In urban habitats, tree damage in the form of bark gnawing, twig/bud chewing, and tree flower/cone feeding was widespread. An example would be the very noticeable flagging of cottonwood branches caused by squirrel bark removal during summer in riparian corridors all along the Front Range, including the Purgatoire River just east of I-25 in Trinidad.

Western Spruce Budworm (*Choristoneura occidentalis*)

This defoliator of Douglas-fir, true firs, and spruces is at low levels over most of the state, with only 35,729 acres being reported during 2001 aerial surveys and similar levels anticipated for 2002 once this year's totals are compiled. Hotspots at present include the Uncompahgre Plateau from north of Norwood northeast to the Black Canyon of the Gunnison, and northwest of Pagosa Springs in the Weminuche Wilderness.

Conditions, including those induced by the drought, are conducive to an expansion by this insect. It is thought the widespread late frosts of 2001, which killed much of the new growth upon which this defoliator depends, knocked back or delayed this expansion. We should anticipate this insect in the near future. If in fact it returns as anticipated, it is likely the total area will include some which are much more valuable to humans as residential forests and recreation areas than the areas in which it currently occurs. As such, it will demand more attention and debate over the appropriate response forest managers should take.

Accepted management options for western spruce budworm now include aerial spraying with *Bacillus thuringiensis* (the short-term answer in some situations) or silvicultural modification of forests (the long-term answer). The general silvicultural prescription for budworm is to create a forest made up of diverse, even-aged patches of forest and that has individual stems within each patch thinned to a fairly-wide spacing. From a distance, such a forest would appear aesthetically pleasing and variable. At any one point on the ground, the forest would appear open and fairly uniform. (Paige, see me if you want the rationale for why this scheme works to reduce budworm impacts.) Other silivicultural guidelines include replacing non-seral species (such as Douglas-fir and others favored by budworm) which now grow (because of fire-suppression) on sites more suited to seral species (such as pine) back to pine.

Gypsy Moth

No moths were caught this year (250 delimitation traps and 1219 detection traps). A known population in Arvada (first detected in 2000) was heavily trapped (202 traps) and no moths were caught. This is good news and indicates that the population did not succeed at establishing itself. Perhaps this is one of the few benefits of the drought, in that it is speculated that most defoliating insects did not do well this year when presented with foliage that did not appear from buds in synchrony with their hatch and/or that was toughened up too quickly by the early hot temperatures present in late spring/early summer this year. The"no-catch" results from this year's trapping also affirms that the CSFS/Colorado Department of Agriculture/USDA-APHIS decision not to aerially spray BT this summer per normal protocol (in deference to potential public fear of bacterial spraying generated by Sept 11) was correct.

Plains Issues

.Pinewood Nematode was isolated from dead Scots pines in a Kimball, NE windbreak, a mere 17 miles from the northern Colorado border. While this organism and the associated pine wilt disease has still not been confirmed for Colorado, it most certainly exists on our eastern plains. A concerted effort will be made to find it in 2003.
.Incidence of Dutch Elm Disease was notably down in 2002. Speculating, this was either because detection efforts were minimal owing to the preoccupation of foresters with the fire season, or because of the drought reducing fungal development and contamination of bark beetles, or because drought symptoms somewhat masked those of DED or all (or none) of the above.

.No pine sawfly outbreaks were reported on the eastern plains in 2002, either in plantings or the Black Forest.

.Randy Moench reports problems in serviceberry seedlings at the CSFS Nursery from Eriosoma woolly aphids, presumably *E. americanum*.

. Randy Moench also noted a tip dieback of Rocky Mountain junipers that resulted from an unknown species of thrips.

.*Scolytus muticus* was found in American hackberry in Fort Collins, some 150 miles west of its previously known westernmost haunts in western Nebraska and extreme northeastern Colorado. It was found in limbs killed by fox squirrel girdling in a cemetery.

.The blizzard of March 2003 (characterized by wind and excessive moisture) resulted in widespread tree breakage throughout the Front Range of Colorado. Snow fall amounts of 2-4 feet were not uncommon at the western edge of the plains and increased to 6-8 feet in some mountain locations! Of note were the species of trees suffering the most damage: American hackberry, and all conifers (particularly upright junipers, Colorado blue spruce, pinyon pine, mugo pine, ponderosa pine). Other species suffering heavily were: American elm and various woody shrubs. All other species with defect also sustained heavy breakage. Species normally labeled as "storm prone" such as cottonwood, Siberian elm, Russian olive and silver maple did not suffer heavily unless they had obvious defect. Trees which did very well were honeylocust and oaks. Tree experts attribute the unusual breakage to the very dry, brittle condition in conifers (and some of the deciduous species) prior to the storm in combination to the extreme weight they were forced to bear. Architecture was no assurance of immunity to this storm.

.Cedar bark beetles (*Phloeosinus* spp.) are beginning to show up in our most drought tolerant conifers (*Juniperus* spp.) and this is perhaps the best indicator of the depth and severity of the current drought. Flatheaded borers, such as *Chrysobothris texana*, are also being found in these trees but are not thought to be playing more than a secondary role in the tree death.

.Animal damage is greater than normal on the eastern plains. Primary species involved in gnawing bark from species like cottonwood, Russian olive and Siberian elm are fox squirrels and porcupines. Calls from homeowners were up significantly. The increased tree damage is attributed to a lack of other foods from the diets of these species due to the drought.

Dave Leatherman
Colorado State Forest Service
Colorado State University
Forestry 214
Fort Collins, CO 80523-5060
970/491-6303
dleather@lamar.colostate.edu

North Dakota - Woody Plant Disease Research - Jim Walla, NDSU Plant Pathology

Report for Great Plains Tree Pest Council meeting, Sterling, CO, April 9-10, 2003

1.Chokecherry X-disease (Primary current research) (cooperators include Dai, Cheng, Guo, Knudson):

Situation: X-disease is the limiting factor in the use of chokecherry in the northern Great Plains; no controls are available. Disease tolerance/resistance, if it exists, would be the best control. Regional chokecherry seed source provenance plantings established in 1983 by the USDA Plant Materials Center (PMC) near Apple Valley, ND and Ft. Sully, SD, as well as native and planted stands of chokecherry, are being examined to search for tolerance to X-disease; more than 20 promising plants have been identified. Research to confirm the existence of tolerance in those select plants is underway. Select plants need to be propagated, and standard pathogen isolates need to be selected. Variability in the pathogen needs to be considered during tolerance studies, development of better detection methods, and basic understanding of phytoplasma genetics. Genetic engineering to develop disease resistant lines could provide a superior disease management option.

RESULTS:

- **Select plant development**: Production of 24 putatively tolerant chokecherry clones and 8 clones with a range of non-tolerance is progressing. Adequate numbers of the various clones for one trial are large enough to graft inoculate, so a field plot will be out-planted in 2003. Aggressiveness of X-disease phytoplasma isolates is being evaluated to select isolates for inoculations.
- **Genetic engineering for X-disease resistance**: Started research with Dr. Dai, NDSU Plant Sciences, to insert the PAP-Y gene to develop disease resistant chokecherry clones. Regeneration of chokecherry plants from leaf tissues was accomplished.

Future: **1)** All plants will be rated for X-disease severity in both the Apple Valley and the Ft. Sully planting in 2003. The ratings at Apple Valley will be used to further characterize the X-disease epidemic there and to monitor the condition of the previously identified select plants. The ratings at Ft. Sully will be used to identify additional select chokecherry germplasm. **2)** Seedlings inoculated in 1999 and 2001 will be assayed to determine infection status in time to select isolates for inoculation of the 2003 field trial. **3)** Additional grafting will be done in 2003 to identify graft methods that are more reliable.

2. Ash yellows of green ash (cooperators include Dai, Cheng, Guo):

Situation: Green ash is the most important tree species in North Dakota. Research on ash yellows (AshY) in ND was initiated with the discovery of symptomatic trees in 1993. Research has involved determining incidence and impact in ND and the Great Plains region. AshY phytoplasmas are widespread across the Great Plains and adjacent Rocky Mountains, occurring in 50% of randomly sampled trees and 96% of systematically sampled sites. Because of the serious potential threat of this disease to our forestry resources, research is needed to characterize incidence, current or potential impact, and management. Research in progress and in the planning stage involves determining the impact on commercially available ash cultivars and rootstocks, and developing management techniques, including identification of AshY-tolerant green ash germplasm.

RESULTS:

1) Green ash seedlings were inoculated in 2000 with 10 AshY phytoplasmal isolates from eastern ND and 3 standard strains. The third year of isolate testing supported earlier results, so standard tester isolates to evaluate tolerance of ash cultivars to ash yellows are now available.

2) 19 ash cultivars that are recommended for use in this region are being propagated to evaluate their relative AshY tolerance. Rootstocks of a moderately and a highly tolerant green ash cultivar are needed for evaluation of AshY tolerance of the 19 cultivars. These rootstocks will be identified from among the 19 cultivars. For this, the cultivars must be grown on their own roots. Grafting of the cultivars onto seedling rootstock was highly successful, and produced materials available for rooting. Rooting of softwood cuttings and hardwood cuttings essentially failed. Propagation of ash cultivars on nurse roots for selection of standard rootstocks again yielded good graft success, but self-rooting has not yet been accomplished. Adequate numbers of nurse-root grafted plants were obtained for attempts to root in 2003.

3) A cooperative project was started with Dr. Dai to get clonal material of the 19 ash cultivars in tissue culture for subsequent evaluation for standard rootstocks.

Future: **1)** Scions on nurse roots from 2001-2002 will be grown out to attempt to induce rooting from the scions. **2)** Green ash cultivars that were inoculated in 1999 and 2001 will be assayed for phytoplasmal infection to allow quantification of variation in aggressiveness of ash yellows phytoplasma isolates. **3)** A study to evaluate tolerance of seed sources of green ash seedlings produced at Lincoln-Oakes Nursery for rootstocks will be developed to identify select sources. **4)** Work with Dr. Dai to genetically engineer ash with genes to confer resistance to AshY phytoplasmas.

3. Phytoplasma detection (with Guo and Cheng):

From 2000-2002, five simplified DNA preparation procedures for PCR amplification were tested for detection of phytoplasmas from infected herbaceous and woody plant tissues. Infected root tissue was treated by 1) grinding in sodium hydroxide, 2) sonicating in water, 3) microwaving in water, 4) boiling in sodium hydroxide, or 5) directly placing in PCR tube. All 5 procedures provided phytoplasmal DNA for PCR amplification from an infected herbaceous plant, Catharanthus roseus (periwinkle), while 3 procedures (1, 3, 4) also allowed positive amplification from a woody plant, Fraxinus pennsylvanica (green ash). These methods provide great savings in time and lab materials, making PCR disease testing and indexing of plant materials a better option.

4. Western gall rust and other rusts of pines (with Wang, Tuskan, Cheng):

Situation: Western gall rust poses a substantial disease threat to pines in ND. Research is underway to both understand the biology of the pathogen and to gain a basis for developing disease resistance. A stock collection of *Peridermium harknessii* axenic cultures is being maintained to study the nuclear cycle, to obtain better control over pathogen variability and inoculation conditions for resistance studies, to manipulate nuclei for use in pathogen virulence and host resistance studies, to provide large amounts of genetic material for use in population and evolution studies, and to enable long-term maintenance of virulence types.

Other stem rusts of pines are currently of minor importance for ND, but they are monitored and worked with to keep track of their incidence and take advantage of learning situations. Axenic cultures of *Cronartium comandrae* and *C. quercuum* f. sp. *banksianae* are being used for

comparison with those of western gall rust. Periodic surveys for comandra blister rust and white pine blister rust in native and planted pines and of alternate hosts are needed to provide information regarding incidence, damage, and possible source of infection.

RESULTS:

- Axenic culture:

1) Isolates of *Cronartium quercuum* f. sp. *banksianae* and *C. comandrae* in axenic culture were described for the first time.
2) Nine media were tested for best axenic growth of *Peridermium harknessii*, *C. quercuum* f. sp. *banksianae*, and *C. comandrae*, and one described by Yamazaki and Katsuya in 1987 was best. Some forms of these rusts grew better on that medium with additional KNO3.
3) Isolation of *P. harknessii* into culture from spores was reported for the first time. A medium normally used for orchid culture was the only one on which colonies developed from spores.

- Symptom development - Symptoms of western gall rust were observed over time to characterize their development and to find which are indicative of susceptible responses.

1) The first symptom on the epicotyl, dark purple lesions, was present 3-4 weeks after inoculation. Subsequent symptoms on or near the epicotyl, in approximate order of appearance, were splits, large purple lesions, dry lesions, faint purple lesions, pink pigment on the needle base, water soaked spots, and resin (all termed pre-gall symptoms), and broom branches, swellings, galls, and infections (all termed post-gall symptoms). Among these symptoms, the post-gall symptoms of swellings and galls were used to indicate successful infections. Percentages of seedlings with dark purple lesions, splits, broom branches, swellings, or galls were the traits that were most indicative of susceptibility or pathogenicity.
2) Dark purple lesions were the earliest symptom that could be used as an indicator of relative susceptibility, but splits in the epicotyl were a more reliable early indicator.
3) Large purple lesions and dry lesions were not correlated with successful infection and may be resistant reactions.
4) Swellings and galls were most reliable for characterizing host, inoculum, and interaction effects.

Future: Axenic cultures and previously tested pines will be maintained. Additional research planned includes manipulation of the rust fungi in axenic culture to obtain aeciospores capable of infecting a host and determining which differences among the various media allow development of germinating aeciospores into axenic colonies.

5. Lophodermium resistance in pines

Situation: Lophodermium needle blight has caused sereious defoliation to ponderosa pine in northeast ND. Apparent resistance was observed, indicating the possibility of selecting resistant seed sources. In 1986, 100 seed source provenances of a regional ponderosa pine trial were planted specifically to identify seed sources resistant to this disease. Although established for the Lophodermium study, this germplasm collection has additional uses. Among them are evaluation of the general performance of the various provenances for use in identifying superior seed sources for ND (this is the only remaining evaluated planting in ND) and evaluation of resistance to western gall rust, which has infested the planting. The pines were inoculated in 1999 using needles with fruiting bodies of an undescribed *Lophodermium* species to identify sources of resistance. A fast-moving fire swept through the planting in 2000 and killed the needles and branches in the lower canopy. None of the inoculum appeared to survive the fire. It was not

possible to determine if there were infections in 1999.

RESULTS: The trees were inoculated with Lophodermium in 2002 by tying infected needles to live shoots throughout the planting.

Future: Inoculations will be repeated in 2003 to introduce Lophodermium uniformly across the planting.

Recent Publications

Guo, Y.H., Cheng, Z.-M., and Walla, J.A. 2003. Rapid PCR-based detection of phytoplasmas from infected plants. HortScience (In press).

Walla, J.A., Jacobi, W., and Schmidt, R.A. 2003. Forest pathology for the last century: A retrospective and directions for the future. Phytopathology (In Press).

Jackson, M.B., Glogoza, P.A., Knodel, J.J., Ruby, C.L., and Walla, J.A. 2002. Insect and disease management guide for woody plants in North Dakota. Revised May 2002. NDSU Extension Service Bulletin F-1192.

Jackson, M.B., Walla, J.A., and Hatterman-Valenti, H.M. 2002. Development of juneberry as an agroforestry crop in North Dakota. Pp. 176-178, In: Proc., Seventh Biennial Conference on Agroforestry in North America and Annual Conference of the Plains and Prairie Forestry Association, August 13-15, 2001, Regina, Saskatchewan, Canada.

Walla, J. A. 2003. Axenic culture of *Peridermium harknessii*, *Cronartium quercuum* f. sp. *banksianae*, and *Cronartium comandrae*. In: Xu, M.-Q., J.A. Walla, et al (eds). Proceedings of the 2nd IUFRO WP 7.02.05 Rusts of Forest Trees. 19-23 August, 2003, Yangling, People's Republic of China. (In Press).

Wang, C., Walla, J. A., Tuskan, G. A., Cheng, Z.-M., and McClean, P. 2003. Western gall rust symptom development on ponderosa pine seedlings. In: Xu, M.-Q., J.A. Walla, et al (eds). Proceedings of the 2nd IUFRO WP 7.02.05 Rusts of Forest Trees. 19-23 August, 2003, Yangling, People's Republic of China. (In Press).