Proceedings
of the 60th Annual
Western Forest Insect Work Conference

Some like it HOT!

Spokane, Washington
March 23-25, 2009

WESTERN FOREST INSECT WORK CONFERENCE

2009 Executive Committee

Katharine Sheehan, Chair
Connie Mehmel, Secretary
Karen Ripley, Treasurer
Jennifer Burleigh, Councilor
Bill Riel, Councilor
Joel McMillin, Councilor

Organizational Standing Committees

Barbara Bentz, Founders Award Committee Chair
Darrell Ross, Memorial Scholarship Committee Chair
Boyd Wickman, Malcolm Furniss, and Sandy Kegley, History Committee Co-Chairs
Brytten Steed and Bill Ciesla, Common Names Committee Co-Chairs
Kimberly Wallin, Memorial Scholarship Fundraising Committee Chair

2009 Conference: Some like it HOT!
Spokane, Washington March 23-25, 2009

Program Coordinators: Iral Ragenovich and Beth Willhite
Local Arrangements: Connie Mehmel
Registration Coordinator and Souvenirs: Glenn Kohler
Field Trip: Mike Johnson and Darci Carlson
Silent Auction: Steve Cook and Kimberly Wallin
Technical Equipment Assistance: Ben Smith
Poster Session: Tom Eckberg
Photographs: Bill Ciesla and Ron Billings
Student Presentations: Andy Eglitis and Rob Flowers
Retiree Liaison: Bruce Hostetler
Transportation-sharing Coordinator: David Jack
Local Transportation: Jeff Moore
Proceedings: Karen Ripley

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CONFERENCE SCHEDULE

<u>Monday – March 23, 2009</u>
1:30 – 8:00 **Registration**
4:00 – 6:00 **Executive Meeting**
6:00 – 8:00 **Reception**

<u>Tuesday – March 24, 2009</u>
7:30 - 8:00 **Morning Coffee**
7:30 – 12:00 **Registration**

Opening Sessions
8:00 – 8:30 **Introduction and Orientation**
8:30 – 9:15 **Opening Address** – John Acorn
“Bugs, Forests, and Change: A Nature Nut’s Perspective”
Speaker Introduction – Beth Willhite
9:15 – 10:00 **Scholarship Presentation** – Greg Smith, “An Assessment of Interactions Between Endemic Mountain Pine Beetles and a Secondary Bark Beetle Species.”
Speaker Introduction – Darrell Ross
10:00 – 10:30 **Break & Group Photos**
10:30 – 11:00 **Perspectives on the 1910 Fires**
Sarah Wilson, Zone Archeologist, Idaho Panhandle National Forest, “The 1910 Fires: The History and Human Side”
Art Zack, Ecologist/Silviculturist, Idaho Panhandle National Forest, “Ecology, Before and After the Fire”
Speaker Introductions – Lee Pederson
11:00 – 12:00 **Initial Business Meeting** – Katharine Sheehan, WFIWC Chair
12:00- 1:30 **Lunch**
1:30 – 3:00 **Graduate Student Presentations**
Ecology Session Moderator – Andris Eglitis
Technology Session Moderator – Rob Flowers
3:00 – 3:30 **Break & Group Photos**
3:30 – 5:00 **Concurrent Workshops I**
Are Current Insect Outbreaks Unprecedented? What Can History Tell Us? Moderator – Sandra Kegley
Where We Are, and How Did We Get Here? Forest Insect Conditions in the West Moderator – Ken Gibson
Hard Times for Hardwoods – New Problems for Walnuts, Oaks and Elms in the Western U.S. Moderator – Tom Coleman
5:00 **Fun Run on the Riverwalk** – Coordinated by Sheryl Costello
6:00 – 9:00 **Founder’s Award Banquet**
Introduction and Plaque Presentation – Sandra Kegley and Ken Gibson
Founder’s Award Recipient – Ladd Livingston
Entertainment by Big Red Barn, a non-traditional bluegrass band
No-Host Bar

Wednesday - March 25, 2009

7:30 - 8:00 **Morning Coffee**

8:00 – 9:30 **Concurrent Workshops II**

Current Aerial Survey Techniques and Data Uses
Moderator - Keith Sprengel

Invasives on our Doorstep Moderator - Steve Munson

Mountain Pine Beetle and High-Elevation Pine Management
Moderator – Carl Jorgensen

Scales, Adelgids, and Other Meristematic Insects
Moderator - Bobbe Fitzgibbon

9:30 – 10:00 **Break & Group Photos**

10:00 – 11:30 **Plenary Session – Fire and Insect Interactions** Moderator - Rob Progar

"Fire History and Behavior Mechanisms in the West" – Donald McKenzie

"Effects of Forest Insects on Fire Risk and Behavior" – Richy Herrod

"Influence of Fire on Insects" – Joel McMillin

11:30 – 12:00 **Assemble for Field Trip**

12:00 – 5:00 **Field Trip** – Mike Johnson and Darci Carlson

6:00 – 9:00 **Poster Session, Silent Auction, and Wine Tasting**

Poster Session - Tom Eckberg

Silent Auction—Steve Cook and Kimberly Wallin

Scholarship Memorial Fundraiser Wine Tasting - Beth Willhite

Thursday - March 26, 2009

7:30 - 8:00 **Morning Coffee**

8:00 – 9:30 **Concurrent Workshops III**

Non-traditional Pesticides and Biocontrol for Defoliators Moderator -Cynthia Snyder

Fire and Insect Interactions Moderator - Bob Cain

Semiochemicals to Suppress Bark Beetles: Practical Aspects to Date Moderator – Dave Wood (Nancy Gillette)

9:30 – 10:00 **Break & Group Photos**

10:00 – 11:15 **Plenary Session – Forest Insects and Climate Change** Moderator - John Lundquist

"Climate Change and Its Effects on Western Forest Vegetation" – Jeremy Littell

"Effects of Climate Change on Forest Insects" – Steve Cook

"Effects of Forest Insects on Climate Change" – Jeff Hicke

11:15 – 12:00 **Final Business Meeting** – Katharine Sheehan, WFIWC Chair
12:00 – 1:30 **Lunch**
1:30 – 3:00 **Concurrent Workshops IV**

Beyond the Science of Climate Change – Where Do We Go From Here?" Moderator – John Lundquist

Invasives on Our Doorstep – How State and Federal Agencies Are Responding Moderator -Ron Billings

Cone and Seed Pest Workshop Moderators – Ward Strong and Robb Bennett

3:00 – 3:30 **Break & Group Photos**
3:30 – 5:00 **Concurrent Workshops V**

International Forest Entomology Moderator – Nadir Erbilgin

Defoliator Dynamics and Changing Management Needs Moderators – Lorraine Maclauchlan and Jennifer Burleigh

Research Updates on Bark and Ambrosia Beetles Moderators – Dan Miller and Brytten Steed

5:00 **WFIWC Adjourns!**

MINUTES OF THE EXECUTIVE COMMITTEE MEETING
23 March 2009

Meeting called to order 16:00 by Chair Kathy Sheehan.
In attendance:

Kathy Sheehan, Executive Committee Chair
Karen Ripley, Treasurer
Connie Mehmel, Secretary
Jennifer Burleigh, Councilor
Joel McMillin, Councilor
Bill Riel, Councilor
Bill Ciesla, Co-Chair, Common Names Committee
Ken Gibson, Chair, Founders Award Committee
Darrell Ross, Chair, Memorial Scholarship Committee
Steve Cook, Silent Auction Coordinator 2009
Beth Willhite, Program Committee Co-Chair 2009
Andy Eglitis, Student Presentations Co-Chair 2009
Glenn Kohler, Registration Chair 2009

Old Business
Executive Committee Minutes for 2008 were read by Connie Mehmel. Bill Ciesla moved to accept the minutes as read; second by Joel McMillin. Minutes were approved.

It was noted that the 2008 minutes included approval of three letters to be written by the Executive Committee Chair: a letter of thanks to Professor Nathan Bender from the University of Idaho for arrangement of the WFIWC archives and the posting of the material on the library web page, and letters to the directors of the Pacific Southwest and Pacific Northwest Research Stations, USDA Forest Service, encouraging them to approve deposition of the two historic, USDA, Bureau of Entomology photographic collections into a public archive. It is not known whether former Chair Peter Hall wrote those letters. Jennifer Burleigh will try to find out.

Sheryl Costello is organizing the proceedings of the 2008 WFIWC. They have not yet been completed, but all materials have been gathered.

Upcoming Meetings
WFIWC 2010 will be held in Flagstaff. Joel McMillin will chair the organization committee.

Darrell Ross reported that the location of the National meeting in 2011 has been changed again. It will not be held in Montreal because that location is too expensive, and the expense might impact attendance. The new location is the Marriott hotel in Portland, Oregon. The dates will be May 9-12. The steering committee is Darrell Ross, Dan Hines, Rusty Rhea and Kimberly Wallin.

Deaths
Al Stage and Stan Barris died in the last year. Kathy has a full obituary for Al, and a shorter one for Stan.

Retirements
Bobbe Fitzgibbons plans to retire at the end of March, but will remain involved in the Conference. John McLean will soon retire, and plans to move back to New Zealand. Peter Hall retired last year. His former position is now held by Jennifer Burleigh.

Treasurer's Report
Treasurer Karen Ripley read the Financial Report and submitted it to the Executive Committee. Full report is included after the Initial Business Meeting minutes.

Karen notes that we are the wealthiest of the Work Conferences. Because our conference had gross receipts of over $25,000 last year, the Treasurer had to file a tax return.

Some members, particularly US Forest Service employees, have asked if they could pay registration with a credit card. Bill Riel suggested that we could use PayPal to make this work. There is a charge for using PayPal. People paying with credit cards would have to pay a surcharge. The Entomological Society of Canada is going that route, and the Western Pathology group is starting to explore the option. Use of credit cards would allow full on-line registration. ESC has had to change its bylaws to allow credit cards. Darrell Ross moved that we explore the option of using PayPal; Jennifer Burleigh seconded. The motion passed.

Councilors will check the books today.

2009 Update
Glenn Kohler reported on registrations. We have 131 paid registrations: 102 regular, 17 students, 5 retirees and 3 guests, for a total of $31,160. We have 13 day speakers coming. We have 10 people registered who haven't paid. 22 paid late registration. 125 ordered lunches. $165 has been donated to the scholarship fund.

2009 Program
Beth Willhite reported on the program. We have a higher number of non-affiliated speakers this year than usual. All of the workshops are full. We have four concurrent workshops on Wednesday morning.

Bruce Hostetler prepared guidelines for downloading presentations. The permission of the presenter is required before downloading any presentation. All of the students helping with AV will be given a copy of the guidelines. They will also be added to the website under "Tips for Running a Meeting".

Silent Auction
Steve asked for an announcement to be made telling people with auction items to give them to him.

Beth reported on the wine tasting concurrent with the silent auction. WFIWC has to buy the wine, and WFIWC members have to pour. Cost will be $1 per pour or $5 per glass of wine. We will also be selling wine glasses with the WFIWC logo for $5 each. We have 144 glasses to sell.

We discussed the liability of serving alcohol. Bill Ciesla asked if we had liability insurance in case someone had an alcohol-related accident. If we do this again we should probably get one-day liability insurance.

Beth also organized a WFIWC souvenir trivia contest. The winner will be announced at the end of the evening during the poster session.

Common Names Committee
The Common Names Committee consists of Bobbe Fitzgibbon, Lee Humble, Iral Ragenovich, Lee Pederson, John McLean, and co-Chairpersons Brytten Steed and Bill Ciesla. Bobbe wants to continue with the Committee after retirement. John McLean needs to be replaced, probably with another Canadian. The Committee continues to encourage new submissions. The WFIWC website has a link to the sub-

mission process. By March 2008 four names had been ESA approved, three rejected, four proposed and one in preparation. The process is continuing. Some are new insects. ESC and ESA should get simultaneous submissions. Mexico has no formal common names process.

Founder's Award Committee
Ken Gibson reported that Jesse Logan is the 2009 award winner. Ken has the traveling plaque. Ladd's award will be presented tomorrow. The Committee encourages new nominations.

History Committee
Mal submitted a report on behalf of the three co-chairs. Sandy Kegley is a new co-chair. Mal is submitting photos to put on the website, and he is soliciting stories from others.

Memorial Scholarship Committee
The scholarship committee members are Darrell Ross, Steve Seybold, Terry Shore and Sandy Kegley. Terry Shore wants to be replaced. David Jack will be awarded the 2009 scholarship. David helped with the planning committee this year.

The new deadline for scholarship applications will be February 15 (instead of January).

A $50 donation to the scholarship fund in the name of a deceased member will get that member's name on the scholarship plaque.

Approval of Committee Reports
Jennifer moved that we accept all five committee reports; Ken seconded. Motion passed.

New Business
It is time to appoint a new Secretary to replace Connie, and a new Councilor to replace Joel. Replacements will be solicited.

The Southern Forest Insect Work Conference submitted a "Don't Move Firewood" position paper for our consideration. We had some discussion over who the audience would be. There was no interest in taking on this issue.

Mal Furniss submitted a suggestion that the Conference address the issue of inaccurate websites. This appears to be too big a task for the Conference to take on effectively.

Adjournment
Bill Riel moved that the meeting adjourn; Bill Ciesla seconded. Meeting was adjourned at 17:14.

Respectfully submitted,
Connie Mehmel, Secretary

MINUTES OF THE INITIAL BUSINESS MEETING
24 March 2009

WFIWC Chair Kathy Sheehan called the meeting to order at 8:00 am.
Minutes of the March 23 Executive Committee Meeting were read by Secretary Connie Mehmel. Two corrections were noted:

Ken Gibson is not a member of the Founder's Award Committee.
The winner of the Trivia Contest will be announced at the final business meeting.
The minutes were accepted as corrected.

Kathy Sheehan read obituaries of Al Stage and Stan Barras. The Conference observed a moment of silence for both deceased members.

Several members were congratulated in their retirement:
Bobbe Fitzgibbon plans to retire at the end of March, but will remain involved in the Conference.
John McLean will soon retire, and plans to move back to New Zealand.
Peter Hall retired last year.

Treasurer's Report

Treasurer Karen Ripley read the Treasurer's report. A full report is included with these minutes. She noted that the Conference will be in the black after this meeting. Any member of the Conference may check the Treasurer's books. Connie Mehmel moved that the report be accepted. Bill Riel seconded. The motion passed.

Committee Reports

Kathy Sheehan called for committee reports. She noted that a handout with committee contact information is included in the registration packets.

Common Names Committee

Co-Chair Bill Ciesla read the Common Names Committee report. The committee has seven members. Two are retiring, of whom one needs to be replaced. A copy of the full report is included with these minutes.

Founders Award Committee

Ken Gibson gave the report. He is representing committee chair Barb Bentz. The 2009 recipient of the Founder's Award, Jesse Logan, was announced. Jesse will be present at the 2010 meeting in Flagstaff. All members were encouraged to attend tonight's banquet to honor the 2008 recipient, Ladd Livingston. They are looking for nominations for the 2010 award. Nominations are due by January 15.

History Committee Report

The History Committee report was read by Sandy Kegley. It was noted that sometimes it is hard to get history published. A copy of the full report is included with these minutes.

Memorial Scholarship Committee

Darrell Ross read the Memorial Scholarship Committee report. David Jack of the University of British Columbia is the 2009 scholarship winner. Committee member Terry Shore wants to be replaced. Darrell hopes to have a candidate today.

Silent Auction

Steve Cook is organizing the silent auction. Items should be brought to him. This has been a good way to raise funds for the scholarship. It made $1,100 last year. Silent auction items should be brought to Steve.

Vacancies

Kathy Sheehan reminded members that there are two openings for new committee members. Secretary Connie Mehmel and Councilor Joel McMillin are due to be replaced. Connie and Joel will head up nominating committees to find their replacements.

Future WFIWC

Rich Hofstetter and Joel McMillin brought a poster on the 2010 WIFWC, which will be held in Flagstaff. It will be at the same venue as the 1988 meeting. There are two field trip options. Joel encourages members to vote on the field trip.

Darrell Ross announced that the North American Forest Insect Work Conference 2011 will be held in Portland, Oregon. It will be at the Marriott, the same venue where it was held in 2000. He will be looking for help in planning.

Jennifer Burleigh moved to adjourn the meeting. Dan Miller seconded. The meeting was adjourned at 11:50.

Respectfully submitted,
Connie Mehmel, Secretary

TREASURER'S REPORT **Submitted by Karen Ripley, March 2009**

Highlights of 2008:

Total interest income from CD's and savings account $1582.18

Awarded $750 Memorial Scholarship to Greg Smith

$8,501.00 surplus from 2007 Boulder meeting. Includes $450.00 donated to the scholarship funds during registration and $1,181.50 earned by the Silent Auction. Costello/Aguayo retained $660 for anticipated proceedings expenses. Funds were added to Memorial Scholarship funds and placed in a 9-month CD with 2.34% interest rate.

New contributions to scholarship funds	At Boulder registration	450.00
	Boulder Auction proceeds:	1,181.50
	Donation received	100.00
	For Bill McCambridge	25.00
	Sub-total	1,756.50

Bruce Thomson added Bill McCambridge to Memorial Scholarship plaque.

$100 was donated to "Prevent Child Abuse America" by Mark Schultz in honor of the Professional Entomologists of the Western Forest Insect Work Conference.

Filed 2007 tax return in 2008. As part of our 501 (c) (3) status, anyone who wants to see the tax return may do so. No requests yet.

Assets of WFIWC as of Feb 28, 2008:

Checking Account	$6,470.89	(February 28, 2009 Statement)
Savings Account	$30,114.52	(February 28, 2009 Statement)

CD22198284 Mark McGregor Memorial $5521.64 earning 3.18% interest.
Issued 8/22/2008. Matures 3/20/2009 at $5,622.48.

CD 22278142 Memorial Scholarship $67,803.27 earning 2.34% interest.
Issued February 27, 2009. Matures November 24, 2009.

Issues in 2009:

Ripley will file 2008 tax return in early April 2009.

Surplus funds from prior meetings: Boulder (2008): $8,501;
Boise (2007): $12,400; Asheville (2006): zero; Victoria (2005): c. $20,000;
San Diego (2004): zero; Guadalajara (2003): c. $600.

Expenses associated with Scholarship Awards: Scholarship $750, award plaques and engraving $80, one night hotel (expense of subsequent conference). **Note: Approx. $73,000 in CDs, at 2% interest earns $1460.**

Expenses of Founder's Award: $300 plaque and 1 night's hotel.

Expenses of Scholarship Fundraising: Plaque updates by Contech (PheroTech).

COMMON NAMES COMMITTEE REPORT FOR CY 2008/9

March 2008 through March 2009

Committee Members – As of March 2008, the Common Names Committee (CNC) had full (seven) membership with *Bobbe Fitzgibbon, Lee Humble, Iral Ragenovich, Lee Pederson, John McLean*, and co-Chairpersons *Brytten Steed* and *Bill Ciesla*. Two of the members: *John McLean* and *Bobbe Fitzgibbon* retired during the 2008-09 calendar year. *John McLean* has indicated that he is moving back to New Zealand and will no longer be involved in the CNC. *Bobbe Fitzgibbon* has indicated that she would like to continue to be actively involved with the CNC.

This year the Committee continued to encourage and coordinate the submission of common names for insects discussed in Furniss and Carolin's "Western Forest Insects" that do not have ESA approved common names. The established review and comment process, using links available on the WFIWC official website, continues to work well.

During the period March 2008-2009, four common names submitted to ESA by the WFIWC were approved by ESA, two were rejected and an additional four names have been submitted. One additional proposal is being prepared. There are no new common name proposals under review on the WFIWC website at the present time.

Status of common names proposed by WFIWC members during 2008/09

Approved by ESA Common Names Committee:
- *Rhagium inquisitor* - ribbed pine borer
- *Hylurgus ligniperda* - redhaired pine bark beetle
- *Ips emarginatus* - emarginate ips
- *Dischola quercusmamma* - oak rough bulletgall wasp

Rejected by ESA Common Names Committee:
- *Eriophyes calaceris* - purple erineum maple mite
- *Phaenops (Melanophila) gentilis* - green flatheaded pine borer
- *Dasychira grisefacta* - western pine tussock moth

New proposals submitted to ESA Common Names Committee:
- *Agrilus coxalis* - goldspotted oak borer
- *Ips hunteri* - blue spruce engraver
- *Ips pertubatus* - northern spruce engraver
- *Lophocampa ingens* - southwestern pine tiger moth

New proposals in preparation by WFIWC members:
- *Dasychira grisefacta* - grizzled tussock moth (resubmission)

Proposed activities for the 2009/10 CY include:

- Continue to urge WFIWC members to consider and propose common names for insects in support of the revision of *Western Forest Insects*, which is currently in progress, and propose common names, as needed, for newly discovered invasive species or indigenous insects that have become pests since the 1977 publication of Western Forest Insects.

- Seek replacement for one of the Committee members who have retired.
- Obtain information on protocols for submission of common names to the Entomological Society of Canada and consider simultaneous submission of common names for insects that occur in both western Canada and the United States.

Members interested in submitting proposals for common names should use the form available on WFIWC Common Names website, seek peer review and comment, and submit their proposal to either Brytten Steed or Bill Ciesla.

Respectfully submitted,
/s/ *Brytten E. Steed* and /s/ *William M. Ciesla***,** co-Chairs

HISTORY COMMITTEE REPORT, 2008-2009

It is with great pleasure that Boyd and Mal welcome Sandy Kegley as Co-Chair of the History Committee. She has participated in our history workshops and panels since the 1995 Rapid City meeting and most recently at the 2008 Boulder, CO, meeting where she exhibited a poster about the historical photo link to the WFIWC web page. She is moderating the history workshop at this meeting.

History articles sometimes have a history of their own. The article, Beginnings of forest entomology in Alaska: A spruce beetle outbreak on Kosciusko Island sets the stage, 1946, was slated for publication in History Line by the Forest Service Washington Office. However, Historian Aaron Shapiro, abruptly disappeared and, lacking further contact, the manuscript was submitted to Alaska History magazine but was rejected. The reason being: "It seems that the story is larger than can be presented solely from (Bob) Furniss's perspective." Go figure. Who else was there? So, now, it has been submitted to the PNW station where Bob retired as Assistant Director in 1966. Its reception there was luke warm although it has not yet been rejected.

Aided by webmaster, Kathy Sheehan, Mal has posted many historical photos, accompanied by narratives, on the WFIWC website. Click on the Photos/History link. Just recently, Mal contacted Hector Richmond's daughter, Donnie, who promises to provide the kind of intimate information that only family has. Meanwhile, an initial posting concerning Hec is on the link under Canada. Hec was a WFIWC founder and author of the book, "Forever Green." Also, Imre Otvos has been appointed to solicit recollections of others regarding forest entomology in Canada that will be posted as they are made available.

Professor Nathan Bender, Head of Special Collections and Archives, University of Idaho, visited Mal in August for an over-view of his holdings destined for the archives. Sandy Kegley had done so earlier. When the time comes, they will deposit the designated material, which consists of thousands of photos from several sources, correspondence, and other historical material.

Boyd Wickman is also readying his collection of historical material for eventual deposit. Boyd also volunteers at the Pringle Falls Experimental Forest where he leads tours involving the history of work at that facility including forest entomology.

Submitted by M.M. Furniss, S.J. Kegley, and B.E. Wickman

MEMORIAL SCHOLARSHIP COMMITTEE REPORT, 2008-2009

Darrell Ross, Chair   Members: Sandy Kegley, Steve Seybold, Terry Shore

Five applications were received for the 2009 Memorial Scholarship. Three of the applications were from students pursuing M.S. degrees and two were from students pursuing Ph.D. degrees. The committee selected David Jack, a Ph.D. student at the University of British Columbia working with Dr. John McLean, as the recipient of the 2009 Memorial Scholarship. David's dissertation research is focused on the effects of nitrogen fertilization and pre-attack tree moisture content on the success of mountain pine beetle colonization of lodgepole pine. David will be invited to give a presentation on his dissertation research at the 2010 WFIWC meeting.

The committee encourages all qualified graduate students to apply for the 2010 Memorial Scholarship. The deadline to submit applications is February 15, 2010.

Terry Shore recently asked to be replaced on the committee. A replacement for Terry will be announced in the near future.

MINUTES OF THE FINAL BUSINESS MEETING
26 March 2009

WFIWC Chair Kathy Sheehan called the meeting to order at 11:30 am.

Secretary Connie Mehmel read the minutes of the Initial Business Meeting, which was held on March 24. Karen Ripley moved to approve the minutes as read. Imre Otvos second. Minutes were approved.

<u>Registration</u>

Glenn Kohler reported on registration. We had 131 registered conference participants, for a total of $34,845. We have collected scholarship donations of $165. We still have some flash drives, which can be sold for $10 each. We have already sold $40 worth of flash drives. We have 105 regular registrants, 18 students, six retirees, and three guests. Twenty-six people paid the late registration fee, 10 cancelled.

<u>Treasurer's Report</u>

Karen Ripley gave the Treasurer's Report. We appear to have finished the conference in the black, but we will have to wait until all bills come in before we will know for sure. Karen recognized the members of the planning committee, and complimented the venue. Beth Willhite and Iral Ragenovich put together an excellent program, and Mike Johnson and Darci Carlson put together an excellent field trip. Mike in particular showed his passion for local history. Glenn Kohler was a registration rock star; he put together a highly organized group. Ben Smith may have ruined his own conference experience, but he made the audio-visual operation glitch-free. Beth Willhite showed great creativity in putting together the wine tasting and the trivia contest, which contributed to the richness and enjoyment of the conference.

<u>Committee Report Updates</u>

Memorial Scholarship Committee

Darrell Ross is not here. Terry Shore will be replaced by Ward Strong, BC Ministry of Forests & Range.

History Committee   No updates.

Founders Award Committee   No report.

Common Names Committee: Bill Ciesla mentioned that a lot of common names were used at the defoliation workshop this morning. Some of these may be introduced pests that are not official yet. New pests need to be named if they are important. Proposed names can be submitted on the Work Conference Website.

Silent Auction and Fundraisers

Steve Cook & Pat Ciesla had 47 items for the silent auction. They thank donors and bidders. There are two IOUs. Big ticket items were the fire bug stained glass and the ips wooden plaque from Ladd. Good take, a little lower than last year.

The belt buckles did not sell well.

Karen Ripley won the trivia contest. She only missed three locations/years. Out of 108 points, she got 90. Her award is two wine glasses and a thumb drive.

The Conference had three complementary rooms to raffle. Those rooms went to Kris Waring of Northern Arizona University, Rob Progar, USDA Forest Service in LaGrande, Oregon, and Tim McConnell, USDA Forest Service retired, Chewelah, Washington.

Future WFIWC

WFIWC 2010 will be held in Flagstaff, Arizona. Joel McMillin thanks everyone who voted on the field trip option.

The organizing committee for the North American Forest Insect Work Conference recommends that the 2011 conference be held in Portland, Oregon. Bill Ciesla moved that the location be approved. Terry Rogers seconded. The motion passed.

Nominations for New Officers

Secretary Connie Mehmel nominated Darci Carlson, USDA Forest Health Protection, Wenatchee WA to replace her as Secretary for a term of two years. All members voted in favor.

Joel McMillin nominated Sheryl Costello, USDA Forest Health Protection, Lakewood CO to replace him as councilor for a term of three years. Chair Kathy Sheehan encourages others to consider taking on an office. It is a rewarding service, and it is not as much work as hosting a meeting.

Lorraine Maclauchlan put forward an invitation for 2012 WFICW to come to Canada, somewhere in the southern Okanagan.

Dan Miller moved to adjourn the meeting; Dwight Scarbrough seconded. The meeting was adjourned at 11:49.

Respectfully submitted, Connie Mehmel, Secretary

IN MEMORY

Albert R. Stage, 79, Emeritus Scientist, died on Saturday, July 12, 2008 at home near Moscow, ID.
Al was one of the giants in forest biometrics research and forest growth dynamics modeling in the world. His broad breadth of knowledge, analytical skills, creativity and curiosity, and his sheer love of science, made him a consummate forest scientist. It is noteworthy that his most productive year measured in refereed journal papers was 2007, many years after becoming an Emeritus Scientist. He had more work to do and many more papers planned than his lifetime permitted.

Al was best known for the creation of the Prognosis Model for Stand Development, first published in 1973. This model is the core of what is currently known as the Forest Vegetation Simulator (FVS), the most widely used forest growth model in the world. Al's vision, his quiet but persuasive prodding, and his firm grasp of biophysical, mathematical, and statistical concepts are at the foundation of FVS. Many who had the pleasure of working closely with him stand in awe of his achievements; the fervor and pace with which Al attacked forestry research was exhausting!

Al's Forest Service career started in 1950 with a summer job at the Fort Valley Experimental Forest in Arizona. In 1951 he was hired by the Northern Rocky Mountain Forest and Range Experiment Station and when not on military or educational leave, he supervised the Priest River Experimental Forest in northern Idaho until 1956. He received an M.S. in Mathematical Statistics (1961) and a Ph.D. in Forest Mensuration (1966), both from the University of Michigan. Al was one of the original inhabitants of the Moscow Forestry Sciences Laboratory when it opened in 1963. It was there that he was appointed to his dream job as a project leader, a position he maintained until retirement in 1995.

Al received several awards and honors during his career, including the Distinguished Alumni Award from the University of Michigan's School of Natural Resources, the USDA Superior Service Award, the Forest Service Forest Insect and Disease Award for Research Excellence, and in 2006, the Society of American Foresters (SAF) Award in Forest Science. He was elected a Fellow of SAF in 2000.

In lieu of flowers, the Stage family suggests that memorial gifts be made in Al's name to the American Cancer Society (920 North Washington Street Suite 200, Spokane, WA 99201), the White Pine Chapter of the Idaho Native Plant Society (P.O. Box 8481, Moscow, ID 83843), or the Palouse Land Trust (P.O. Box 8506, Moscow, ID 83843). There will be a gathering in remembrance at the family home (3324 West Twin RD, Moscow) on Friday, July 18, 11:00 am to 2:00 pm. Provided by: Nicholas L. Crookston, Operations Research Analyst, Rocky Mountain Research Station, USDA Forest Service, ncrookston@fs.fed.us

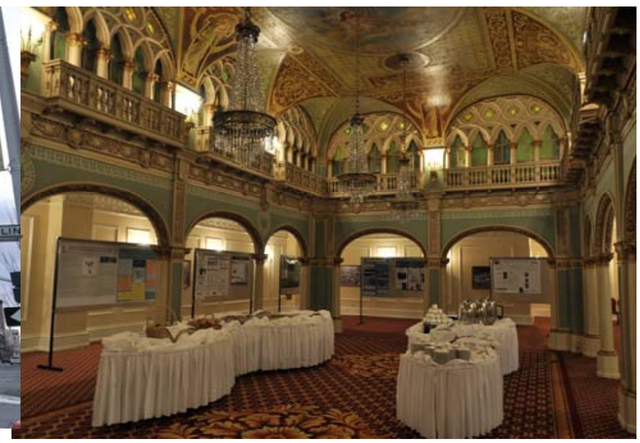
Stan Barras, Ph.D., 72, Peachtree City, died Sept. 20, 2008. Memorial services will be at a later date. Survivors include his wife, Rose Barras, Peachtree City; a daughter, Robyn and Mike Norman, Peachtree City; and grandchildren Olivia and Camille Norman. Carl J. Mowell & Son Funeral Home, Peachtree City, was in charge. (From The Citizen, September 23, 2008, Peachtree City, GA).

Bill Ciesla added: "Dr. Stan Barras should be remembered, even though he was not a western forest entomologist. He worked at Southern Research Station in Pineville, LA on bark beetle mycangia. He did several tours of duty in the Washington Office in the Division of Forest Insect and Disease Research and had a lot of contact with western research entomologists."

INTRODUCTION AND ORIENTATION

Karen Ripley: Planning Committee Chair

Ripley introduced and thanked the members of the planning committee for their hard work and reliability. Each person took specific responsibilities and accomplished the necessary tasks independently. Special mention was given to Connie Mehmel for selecting such a lovely facility, the Davenport Hotel; Iral Ragenovich, unable to attend due to a trip to New Zealand, for her work on the program development; Beth Willhite for developing the meeting materials, arranging the wine activity, and coordinating with Dr. John Acorn; Glenn Kohler for tracking registration so competently; and Ben Smith for sacrificing his enjoyment of the conference in order that the audio-visual equipment is in order and we all can see and hear well. All members of the planning committee and other volunteers were a pleasure to work with and deserve our thanks for the successful conference that resulted from their efforts.



Connie Mehmel: Local Arrangements

The Conference was held in Spokane, the second largest city in the State of Washington and the metropolitan center of the Inland Northwest Region. The city is named for the Spokane Tribe, descendants of the original inhabitants of the region. The name “Spokane” means "Children of the Sun" in *Salish*. Spokane was officially incorporated as a city in 1881, and currently has a population of over 200,000.

The venue was the historic Davenport Hotel, which was built by Louis Davenport in 1914. Mr. Davenport came to Spokane in 1889 to work the summer in his uncle's "Pride of Spokane Restaurant." The summer of 1889 was fateful for Spokane. In August, a conflagration tore through the city, turning 32 square blocks to ashes. Mr. Davenport salvaged what he could from the rubble, bought a tent, and opened "Davenport's Waffle Foundry." He later expanded his culinary offerings to nearly 100 items. Within a few years, Davenport's Restaurant was described by a critic as "the finest thing of the kind in the country."

Mr. Davenport conceived the idea of a grand hotel, and hired architect Kirtland Cutter to design his vision. The Davenport Hotel Company was formed in 1912 and preparation of the site began that year. The hotel tower went up in eight months (1913) using horse carts, steam jacks and hand tools. Not a single worker was seriously injured or killed--a rarity for the time. Cutter and Davenport shopped the world for ideas and furnishings for their new hotel. Ever since opening day, the hotel has promoted itself as "one of America's exceptional hotels." Having risen from the ashes of a devastating fire, the Davenport was an excellent venue for the 60th annual Western Forest Insect Work Conference, with the theme “Some Like It Hot! Insects, Fire and Climate Change in Western Forests.”

OPENING ADDRESS:
Bugs, Forests, and Change: A Nature Nut's Perspective
Speaker: John Acorn, University of Alberta
Summary prepared by Beth Willhite

Work conference attendees were treated to a thought-provoking and entertaining opening presentation by John Acorn, naturalist, author, and television journalist from Edmonton, Alberta. Mr. Acorn, author of 17 books on natural subjects and recipient of numerous awards for science promotion and television, is well-known as the writer and host of the popular television series "Acorn, The Nature Nut," a family oriented, how-to-be-a naturalist show. Currently, he serves as a Faculty Service Officer at the University of Alberta, and travels widely as a public speaker. John set the tone for the work conference by addressing the conference theme (Insects, Fires, and Climate Change in Western Forests) from his personal perspective -- as a naturalist (with a particular knowledge and love of entomology) working with a large and diverse public -- sharing his personal perspectives, observations, and interesting experiences of the world of insects and humans and their oftentimes humorous interactions. His approach to "bugs, forests, and change" used as its basic context the following three questions:

What exists?
What has changed?
What changes what?

John took the audience on a slideshow-illustrated journey exploring various insect population change stories -- from a population explosion of chinch bugs in Medicine Hat, Alberta, following a storm during a dry hot summer, that was mistaken for a mass flight of mountain pine beetle from neighboring British Columbia (local newspaper headline: "The dreaded mountain pine beetle has arrived!") to stories of painted lady butterflies ("we are not good at assessing trends without data"), dragonflies, hobo spiders (do they *really* cause necrotizing bites?), yucca moths in southern Utah, and ladybugs. John (based on repeated first-hand experience) explained that most ladybugs taste somewhat acrid, like "bad salad." However, one particular species posses a more pleasant taste, but it imparts a peanut butter flavor to wine when the grapes in which it hides are made into wine (unfortunately, this is considered a bad thing in wine circles). John also talked about effects on native ladybug populations in Alberta, Canada, resulting from the arrival of the non-native seven-spotted ladybug, in the late 1980's. Some feared the seven-spotted ladybug would eliminate many native species. Surprisingly, of the 75 ladybug species in Alberta, only two closely related native species were affected by the arrival of this non-native insect. Both affected species, which had been habitat generalists, seemingly disappeared from their typical habitats. However, they eventually were discovered occupying very specific habitats. Thus, they unexpectedly responded to the newcomer's arrival by becoming habitat specialists.

The final take-home messages for the work conference attendees, perhaps, were that "change," always an intrinsic feature of the insect world, doesn't always cause the expected (or feared) effects, and that accurate observations and baseline data are necessary to properly assess any type of change.

WFIWC MEMORIAL SCHOLARSHIP PRESENTATION 2009

An assessment of interactions between endemic mountain pine beetles and a secondary bark beetle species
Greg Smith, University of Northern British Columbia

Good morning ladies and gentlemen. Before I begin, I would like to thank the WIFIWC Memorial Scholarship Selection Committee for bestowing this honour upon me.

Today I am going to discuss my Master's thesis research which focused on the interaction between endemic mountain pine beetles (*Dendroctonus ponderosae*) and a secondary bark beetle, *Pseudips mexicanus* (Pm). But first, some general bark beetle biology for the defoliator people in the audience. Bark beetles are typically phloeophagus, feeding on the living tissue just under the bark. Beetles vary in life-cycles and can be semi- to multivoltine in their generation timing. Although some bark beetles, such as the mountain pine beetle are aggressive and may kill large numbers of healthy trees, bark beetles are vital components in a healthy forest ecosystem. Bark beetles are often classified as either 'primary' or 'secondary'. Primary beetles are those which may make use of well defended living hosts, while secondary beetles are relegated to vigour-impaired or recently dead trees.

The mountain pine beetle (MPB) has two stable population phases. The epidemic or outbreak phase consists of large numbers of beetles able to mass attack and overwhelm strong hosts, while excluding competitors. Since this phase causes a great deal of economic damage, epidemic populations have been very well studied. Endemic populations, on the other hand, are small and, similarly to secondary bark beetles, are relegated to unthrifty trees. Consequently, when the number of local MPB is less than 250 individuals per hectare, endemic MPB attack trees previously colonized by secondary species. Further, Carroll et al. (2006)showed that the most common secondary bark beetle associated with endemic MPB was Pm. Pm is indigenous to British Columbia and sympatric with MPB in that province. Its range extends from Alaska to Guatemala and its life history is very poorly understood.

This study was undertaken near Merritt, British Columbia in 2005 to examine the interaction between the two species, as it was unclear what effect the presence of Pm had on MPB attack behaviour and brood production. The research objectives were:

1. Describe Pm life history in lodgepole pine
2. Determine the level of attraction of MPB to Pm aggregation pheromone and host volatiles associated with Pm feeding
3. Investigate the nature of the interaction between Pm and endemic MPB

The life history portion of the research was divided into two components to answer separate questions. The first component addressed attack behaviour and identified, through field study, preferred host condition, gallery morphology and overwintering life stage. The second component was conducted in the lab and examined developmental properties such as development rate, voltinism and instar sizes.

The attack behaviour assessment required the examination of all trees in a series of pine-leading stands, totalling 28 hectares in size, in which 17 trees attacked by Pm were located. The trees were felled and the lower portion removed to allow for emergence of the insects in cages. Upon completion of emergence, the logs were peeled and galleries examined. Ten additional galleries were examined on standing trees. Prism plots were established throughout the stands to determine stand means for a number of tree variables such as diameter at breast height, mean annual increment, phloem thickness and age.The results of the field study indicated that Pm overwinter as adults, allowing early emergence the following year. They typically attacked vigour-impaired hosts low on the bole that had diameters smaller than the stand average. A number of other species were often present, including *Orthotomicus latidens*, *Hylurgops* spp. and MPB.

In the laboratory component, logs were manually infested with Pm and placed in environmental chambers at eight constant temperatures between 14.1 and 33.6 oC. From this, the optimum temperature of development was estimated to be 26.5 oC and the minimum developmental threshold temperature to be 8.5 oC. Using these values, the number of degree days required to complete development from egg to adult was estimated at 890 od above 8.5 oC, which equates to approximately 50 days for complete development. When comparing this information to weather data collected near the study site, it is clear that Pm in central British Columbia is univoltine, as there were only enough degree days available for just less than 1.5 generations.

Examination of larval head capsule widths was done to correct an error in the original descriptive paper for Pm by Trimble (1924), where the reported size for both 3rd and 4th instars was 1.2 mm. The resulting sizes for the four instars from my work followed Dyar's rule, which states that the rate of change between successive instars must be a constant.

The second study explored the potential of MPB to be attracted to either Pm aggregation pheromone or to host volatiles associated with Pm attack. Remember that MPB were found in trees previously colonized by Pm more than any other secondary bark beetle (Carroll et al. 2006). Two trapping experiments were conducted, the first using main components of Pm aggregation pheromone (racemic Ipsenol and Ipsdienol) as bait, the second baited with bolts of pine infested with Pm. In the first experiment, only four MPB were captured, while large numbers of Pm and *Ips pini* were found. The second experiment captured three MPB, but numerous Pm and *O. latidens*.Based on these results, it appears that endemic MPB are not attracted to trees as a result of Pm presence, however, this may have been a limitation of using only a portion of the pheromone plume. Additionally, the host volatiles present may have been altered sufficiently to interfere with any apparent attraction upon the felling of the trees. Even so, it may be that endemic MPB attack trees infested with Pm simply because the two species are responding to similar cues, such as host volatiles produced when a tree is wounded or highly stressed. The choice to attack sub-optimal hosts provides endemic beetles the ability to maintain populations until such a time as when population numbers are great enough to obtain better resources. By eliminating Pm as a factor in endemic MPB host detection, future work can focus on assessment of other possible identification cues such as host condition.

The final experiment addressed two questions:

1. Is the resource available to MPB inferior in trees they attack alone compared to trees they attack with Pm?
2. When both species occupy a common resource, how is MPB reproduction influenced?

To answer these questions, the lower one metre of 12 trees was collected from the 28-hectare study site, five of which were attacked by MPB alone and seven of which were attacked by Pm prior to MPB. These two different species compositions will be called the "infestation types" for the remainder of the talk. The sample size was low, but typical of endemic populations of MPB. The logs were placed in rearing cages to allow beetle emergence, after which, the logs were peeled to examine the galleries.

A couple of the host characteristics measured (diameter at breast height and 10 year mean annual increment) were not significantly different between the two infestation types, but were smaller than the stand mean. Phloem thickness and age were similar for all trees, attacked or not. Trees were also examined for vigour-impairing injuries or pathogen infections. All attacked trees were found to have at least one injury (scars, forked or broken tops) and were often infested with dwarf mistletoe. Most trees were subdominant and suppressed, and the typical indications of strong constitutive defensive responses (pitch tubes) to MPB attack were not present.

Trees attacked first by Pm and subsequently by MPB had higher MPB attack densities and greater phloem usage, but the total amount of phloem used by MPB was always less than 75% of the available material. Pm only used a maximum of 10% in any one tree, suggesting that interspecific competition may not be occurring, as 15% was always still vacant. Phloem use per attack by MPB was typically greater in MPB-only infested trees, but this is likely an artifact of attack density. Additionally, phloem volume used per MPB offspring was greater in trees infested by MPB alone, again a consequence of brood density. Since MBP attack and offspring densities were higher in trees attacked initially by Pm, we should expect shorter ovipositional gallery lengths, as well as, smaller and fewer offspring. However, gallery lengths were of similar dimensions and offspring size was not significantly different. Additionally, the number of female offspring produced per attack was not different between infestation types. Further, an examination of the length of time MPB offspring took to emerge per infestation type after the first beetle emerged in the collecting cages suggested that beetles in MPB only trees took an average of one week longer to complete either development or maturation feeding than beetles emerging from Pm infested trees.

These results suggest that MPB may be occupying a poorer resource in trees they attack alone. Although phloem consumption was less per beetle and attack density greater in Pm infested trees, MPB offspring did not suffer the effects of intraspecific competition. The body size and number of offspring produced were equivalent to those beetles produced in trees where the phloem volume available per beetle was much greater. Additionally, MPB offspring emerged earlier from Pm infested trees, giving those offspring an advantage in terms of first choice of host material and mates.

In summary, this Master's thesis characterized the life history of Pm in southern British

Columbia, found that Pm aggregation pheromone is not attractive to MPB and defined the interaction between MPB and Pm, where it appears that interspecific competition does not occur, but that trees infested by Pm are better resources for MPB and suggests that Pm likely aids in population maintenance of endemic MPB.

Further work is needed to determine the effect Pm has on host chemistry and MPB capacity to locate Pm infested trees.

References

Carroll, A. L., B. H. Aukema, K. F. Raffa, G. D. Smith, and B. S. Lindgren. 2006. Mountain pine beetle outbreak development: the endemic – incipient transition. Mountain Pine Beetle Initiative, Project 1.03 Working Paper, Natural Resources Canada, Canadian Forest Service. 21p.

WFIWC FOUNDER'S AWARD

2009 Announcement: Sandy Kegley

The Founders Award is given to an individual who has made an outstanding contribution to forest entomology in the western North America. The award recognizes significant contributions in pest management, extension-consultation, research, and teaching. Dr. Jesse Logan is the Founders Award recipient for 2009, and will present an acceptance address at the 2010 WFIWC in Flagstaff, Arizona.

Introduction of Ladd Livingston: Ken Gibson

It is my pleasure to introduce the current Founders Award recipient and speaker tonight. I have known Dr. Ladd Livingston ever since the very first work conference I attended in 1985 in Boulder, Colorado. Upon meeting him, I decided that I wanted to be the next Idaho Forest Entomologist, for Ladd is a great role model. Ladd has proved himself over and over as a highly skilled expert on forest insects and practical management, an excellent program manager, a public relations specialist, and a trusted steward of our forests. He is respected for his integrity and hard work, devoting much extra time to anything he undertook, including the many years he spent as an officer of this work conference. Ladd has left a permanent legacy to assist future forest insect and disease managers with his many publications, excellent photographs and training aids. He is a true professional and because of all his qualities, it is very difficult to fill his shoes. Please welcome Dr. Ladd Livingston.

2008 Founder's Award Address

"People and Projects: My Forest Entomology Experiences in Idaho"

R. Ladd Livingston, Forest Health Program Manager, Retired, Idaho Department of Lands, Couer d'Alene, Idaho

It is with great humility that I stand before you as the 16th recipient of the Founder's Award. It is an honor to be listed with those that have preceded me. I stand in awe of their great accomplishments in the world of forest entomology. It is also gratifying to have been privileged to work with several of my predecessors on numerous projects.

As I have contemplated this talk, I have concluded that if there are any actions that merit my nomination to this award, it is because of the people I have worked with and the projects I have worked on, hence, this is what I want to tell you about, People And Projects.

A bit about myself: My father was a career US Forest Service employee, beginning his work as the FS director of a Civilian Conservation Corps project in North Central Washington, near the towns of Twisp and Winthrop where I was born. From there my family moved several times, north to south and back again, always in Region 6, and always on the east side of the Cascade Mountains. In this environment, I loved to run and explore in the forests, enjoying a freedom that my own children rarely had the opportunity to experience. I loved it. We moved from North Central Washington to Central Oregon near John Day and Seneca, then back to Washington to Naches, then up the Entiat River in Central Washington, and finally to Union, Oregon where my father retired. My first real job, beyond weeding the garden, was changing sprinklers in the apple orchards in the Entiat valley. I would arise early, and head for the orchards to change the sprinklers, then go fishing in the nearby river all day long, returning in the late afternoon to once again change the sprinklers, return home for food and rest, and then do it all over again the next day. My younger brother and I often accompanied my father as he went to the woods for his work. We would run and play, with great excitement. I remember one time encountering a very large rattlesnake as we were running through the brush. My brother undoubtedly set a record for the long jump as he vaulted over it.

My first exposure to forest entomology, though I did not recognized it for what it was, was when a western spruce budworm project was set up on the Forest Service compound in Union, Oregon. My mother worked counting or sorting or something. I think that Dick Mason and Boyd Wickman were in charge of that project, though I did not meet them at that time. I was too busy with important teenage things. Things like sports, work, girls, overhauling the motor on my 1946 Plymouth Coupe, and installing a split manifold with straight pipes, for which I received my first citation while loudly advertising my presence on my way out of the nearby town of LaGrande.

After high school, I attended the Eastern Oregon College of Education, now Easter Oregon University, in LaGrande, Oregon, then Brigham Young University for a couple of quarters. A roommate and I decided we were tired of classes and needed something different, so we returned home, signed up with the National Guard, and within a short time found ourselves on six-month active duty marching to the tune of a different drummer. After basic training at Ford Ord, California, we transferred to Fort Sam Houston, near San Antonio, Texas, learning how to be medics. Upon returning home from the army, I was called on a mission for the LDS church, serving for 2 ½ years in the countries of Uruguay and Argentina, learning to speak Spanish in the process. My Spanish was eventually to be very useful in my first official job in forest entomology, a Scolytid collecting trip to Mexico. After returning home from South America I struggled with what to study. I returned to BYU to pursue a dental career, then big game management and finally found the world of entomology. Then I found that there was a discipline known as FOREST ENTOMOLOGY. Heaven was found for sure. I soon discovered that a world-renowned bark beetle taxonomist, Stephen L. Wood, was on the staff at BYU. I had to wait to meet him as he was on a sabbatical digging out specimens for one of his many taxonomic tomes. Steve's work took him all over the world, especially throughout the America's. At that time he was getting ready for one more collecting trip to Mexico and hired me and one other student to accompany him. Real slave labor; I think I received something like 50¢ per hour, but it was a great experience touring all over the mountains of central and western Mexico, living out of the back of his camper. Each day we would spread out to search for specimens, finding many bark and ambrosia beetles including numerous new species. I can remember Steve's excitement once when I brought back a very large *Scolytus* specimen that he did not immediately recognize.

From BYU, I went to Washington State University to work with Alan Berryman, having received an NDEA Fellowship for work on a PhD program. I think Alan was disappointed that he could not get me involved in population dynamics studies, but I had other interests. I settled on the fir engraver *Scolytus ventralis* as the subject of my attention, working on the relationship of the beetle with an associated fungus, *Trichosporium symbioticum*. This fungus is always found with the beetle, being introduced into the tree as the beetles attack, growing through the phloem ahead of the feeding larvae, establishing a favorable environment. Through cooperation with forest entomologists all over the Western US and Canada who sent me infested bolts, I found the fungus to be present throughout the range of the beetle.

One very interesting aspect of my work was to discover spore-carrying mycangial pits stretching from one side of the beetle's head to the other. After some initial discovery done with serial sectioning and staining, I arranged to look at some specimens with a scanning-electron microscope. The only one in the State of Washington at that time was located at the Batelle Northwest Atomic Reactor Works near Richland, Washington. After much negotiation, I made a visit. The security was so tight that they even escorted me to the rest room. The people were very cordial and helpful. For them it was a new experience, as they had never looked at anything that had ever been alive. We mounted my bark beetles heads on copper billets, coated them with a gold film in a vacuum chamber and put them under the eye of the scope. We all whooped with excitement when the heads came into focus, showing clearly the structures that I had seen in the serially sectioned slides.

After graduation, jobs were scarce. In desperation, I took a temporary position teaching human anatomy and physiology to nursing students seeking an RN degree at Peninsula College, in Port Angeles, Washington. I also taught invertebrate labs. Both the college and I were desperate, they, not to lose funding for a new program for registered nurses, and me to support a growing family; we had three children at that time. On many occasions I found myself closing the book on my studies and heading into the classroom to teach what I had just learned. I was gratified however to have all of the nursing students pass with flying colors the physiology/anatomy portion of their National Boards at the end of the term.

All of this fumbling around looking for jobs actually proved to be to my benefit. Unbeknownst to me at that time, there was a big outbreak of the Douglas-fir beetle developing in North Idaho. Decisions had been made to build a dam on the North Fork of the Clearwater River near the town of Orofino. In the process of clearing the land, extensive stands of large, mature Douglas-fir were cut and the logs decked, waiting for the reservoir to fill so they could be floated out. No one thought about the consequences of several years of setting the banquet table for the Doug-fir beetle with all of the cut logs. No one, that is, until the beetles ran out of logs, and simply flew to attack the widespread stands up the slopes. This resulted in a very large outbreak in standing timber and a massive salvage effort. It also provided the stimulus, with the encouragement of Mal Furniss, Bill Ciesla, Royce Cox of Potlatch Corp. and others of the Montana/North Idaho Forest Pest Action Council (M/NIFPAC), for the State of Idaho to hire a forest entomologist. A resolution, proposed by Mal Furniss and written with the help of several others, was prepared and forwarded to the Idaho State Board of Land Commissioners, Boise, on Nov. 22, 1971. Less than a year later, I reported to work in Coeur d'Alene on October 2, 1972.

My employment with the State of Idaho was most enjoyable. It was truly amazing that I could be paid to go to the woods for work and study. Someone had to do it, why not me? In the position, I had the opportunity and challenge to work with nearly every major western forest insect and with several introduced species. I feel that I came on the scene at just the right time to be involved in so many new developments that could be used in the main elements of our program, i.e. survey, evaluation, control, and prevention techniques. I also had the opportunity to be involved in research.

I always felt that the research conducted by so many University, US Forest Service and Canadian experts was just to help me have good tools to share with those looking for help. They did the research; I applied it. A major component of my job was to provide Forest Health information and recommendations to state forest managers, industry foresters and managers, to the approximate 34,000 non-industrial private forest owners in Idaho and to other State of Idaho Agencies. The reasons for owning forested land vary greatly, but potential impacts of insects and diseases on their trees always rated at or near the top of concerns. It doesn't matter why you like trees or what you want to do with them, when they suddenly start to die and turn brown there is great concern. Generally, no one wants that to happen on his or her property. I say generally, because on one occasion while visiting with a number of non-industrial private forest owners and waxing eloquent on the need and methods to keep beetles from killing trees, one lady raised her hand and clearly stated, "Well, I like woodpeckers." Gotcha! Well, most of the time, if landowners want dead trees, they will take care of the killing themselves. They don't want some bug doing it for them. People want living trees, and will do whatever it takes to keep them that way.

For these reasons, Forest Health and Forest Pest Management often presented a different challenge for the State of Idaho, its forest industry and forest-owning citizens, than it does for other agencies. For the State of Idaho, laws mandate that State-owned forests be managed to produce income for the State endowments, the largest of which is education. Thus tree killing and growth loss are classed as "damage to the resource" and are to be dealt with as expeditiously as possible. The emphasis was always on preventing damage through stand management, but when damage occurred, there was an immediate salvage and utilization effort.

In our Idaho program, the main emphasis was always on prevention; truly, an ounce of prevention is worth a pound of cure. With this objective in mind, I sponsored and participated with the University of Idaho Extension, the US Forest Service and numerous other forest interest groups in producing hundreds of training sessions, field trips and conferences. In these sessions we provided information on insect identification, population status, insect/host interactions, and tree and stand management, all aimed at providing long-term suggestions for preventing problems from developing, or how to deal with them if they occurred.

From some IDL reports for the six years 2000 – 2005, I found the following information representing a sample of my participation in these activities:

- ►3,114 PERSONAL, ON SITE AND/OR PHONE CONTACTS
- ►177 TRAINING SESSIONS/CONFERENCES
- ►8,697 PEOPLE TRAINED IN FORMAL SESSIONS

As I mentioned earlier, Mal Furniss, Research Entomologist at the Intermountain Station at Moscow, Idaho had a principal role in getting the forest entomologist position established by the State of Idaho. It was my distinct pleasure to work with Mal on several projects, mainly with bark beetles and pheromones. The first was with the pine engraver to determine the inhibition by Ipsenol to the attraction of bolts serving as bait. We made little round cages of hardware cloth, covered them with stickem-special, put bolts of freshly cut ponderosa pine inside, and then observed the differences in catches between treated and untreated. I know that Mal prepared a publication for the Environmental Entomologist to report the results, but the only thing I remember was how sticky the whole mess was. I think the reason Mal invited me to participate in the study was that he needed an unknowing person to do the sticky work.

Of much greater significance, at least in terms of trees killed and impacts on the forest industry of Idaho was Mal's work on the Douglas-fir beetle. As previously mentioned, this beetle got me my job, so it has always a favorite. It seemed to be for Mal also as he spent a good portion of his career discovering the parameters of susceptible stands, population dynamics of the initiation, duration and decline of outbreaks, and the role of pheromones, especially MCH, in regulating beetles, and in the opportunities for use of MCH in managing populations. I had the good fortune of working with Mal, and with Mark McGregor of FHP in Missoula (for whom the Founders Award was initiated) in several of these studies. Mal recently sent me an e-mail message summarizing the relevant aspects of stand susceptibility and beetle outbreaks:

> "The (picture) of a dense stand and of Chuck Heppner sums-up the 3 ingredients of a susceptible stand:
> **1. Plurality of DF 2. Mature DF and 3. Dense stand.** Without any one of those characteristics there is no DFB. Further, in the northern RM, all outbreaks have developed (released) in snow- or ice-broken or downed trees that lack defensive response. The amount of subsequent tree mortality depends on the DFB population and extent of available susceptible trees. Live trees are a population sink and the DFB population decreases stepwise and subsides by the 3rd year." E-mail from Mal Furniss to Ladd Livingston, January 2009.

I worked with Mal on surveys to formulate these ideas, and I used these concepts in dealing with the DFB throughout my career. On State of Idaho lands, we commonly and successfully reduced stand density as a very effective preventive measure. We also used annual monitoring and immediate removal of infested trees as a tool to prevent population build-up. On State lands throughout Northern Idaho, we had a number of jypo loggers who would literally scour the woods looking for new DFB beetle groups. As soon as a group of faders was found, they were in the local IDL office seeking authorization for a direct or salvage sale and immediate removal of the beetle-infested trees. After several field visits to show them how to recognize newly attacked trees, they were even finding new, current year attacks before the trees faded.

The development and use of MCH was another very exciting project with Mal. The successful testing of MCH, applied by helicopter, to prevent beetle attacks of felled trees led to an operational project using the same technique in North Idaho. In the fall of 1983 a severe windstorm ran the length of Dworshak Reservoir, the lake that filled behind the dam on the North Fork of the Clearwater River, the same drainage previously mentioned as the site of the DFB outbreak that lead to the entomology position with the Idaho Department of Lands. Microbursts bounced from one side of the reservoir to the other, breaking and uprooting thousands of trees for miles along the reservoir damaging an estimated 100MM bf of timber, of which 10MM bf was Douglas-fir. Nearly all of the affected land was owned by Potlatch Corporation, the State of Idaho, or the Federal Government and administered by the Corps of Engineers. Potlatch and the State immediately pushed forward with a very aggressive salvage program, retrieving nearly all the downed trees on their respective ownerships. However, the Corps of Engineers had no interest in conducting any salvage operations, and the State owned some land on the steep slopes immediately above the waterline that made salvage impossible. WHAT A QUANDARY! WHAT TO DO? This time everyone remembered well the impacts of leaving down trees for the beetles to infest and did not want it repeated. With the recent success of the helicopter applied MCH, Mark McGregor and I put together a project to do our best to prevent the buildup of the DFB populations. Mark worked to incorporate 2% MCH into macromelt plastic pellets and to get a seed spreader modified for the application. I worked to identify and map out all of the areas that needed to be treated. The Corps of Engineers participated by providing a floating, mobile helibase made up of several big barges they had used in the cleanup of the reservoir. We treated 2400 acres. In a post treatment evaluation, we found that the treated trees averaged just over two attacks per tree (98 trees sampled), while the untreated trees (88 trees sampled) averaged 51 attacks per tree. The bottom line was that we did not experience any increase of beetle activity in the treated areas, whereas there were increases in untreated sites.

In recent times, we have utilized MCH bubble caps in a wide variety of circumstances. There are hundreds of examples where MCH bubble-caps have been used to protect trees, continuing to this day. The list of Idaho users includes State Forest managers, NIPF owners, cabin and recreation site owners, State Parks, campgrounds, and large acreage owners, all of whom have experienced excellent success with this technique.

The Douglas-fir tussock moth has also been a repeating challenge for Idaho. Approximately every 10 years we have dealt with an outbreak in the northern portion of the state. The first for me was in 1974 when Idaho participated with Oregon and Washington in treating the tussock moth with DDT under emergency authorization, to the tune of $4 million covering 400,000 acres in the three states. This was the last use of DDT in a forest environment in the USA. I visited near LaGrande, OR with LeRoy Kline, Entomologist with the Oregon Dept. of Forestry and saw first-hand the devastation that was occurring on private lands, heavily impacting the landowners. This strongly impressed on me the need to be able to help these private woodland owners with their forest pest challenges.

The need for better understanding of population dynamics, stand susceptibility and different treatment methods and compounds lead to the Expanded Research, Development and Application program of the

US and Canadian Forest Service, and the ultimate publication of the Tussock Moth Compendium, and many practical "How-To" guides. I had the opportunity of participating in this program, working primarily on the Outbreak Detection and Evaluation component. We worked with Gary Daterman in his development of a pheromone-based early detection system. We participated in testing strong baits, weak baits and in implementing an operational trapping program. I believe that we had the longest running trapping history in the program.

The last tussock moth outbreak that I dealt with surfaced in 2000. Aerial detection surveys mapped extensive defoliation in Northern Idaho across virtually the same geographical area as the previous Northern Idaho outbreaks. Egg mass levels were surveyed during the winters of 2000/2001 and 2001/2002. This information, coupled with the aerial defoliation survey maps, was used to determine potential spray boundaries. We worked with Imre Otvos, Pacific Research Centre, CFS, to determine if virus levels might be high enough to bring a collapse to the population. Unfortunately, that was not the case.

Landowners were given the option of participating if they desired. In 2000, of 1167 owners contacted, 484 decided to participate including industry, non-industrial private owners, the University of Idaho, Coeur d'Alene Tribe, City of Troy, State Parks and the Idaho Department of Lands. Two pesticides were applied, Dimilin 4L (DFB) (60,224 acres) and Foray 48B (*Bt*) (16,268 acres) The Foray was used for stream buffers, and as an option to the landowners who so chose. In 2001, we only used Dimilin. I believe that we were the first for an Interior West spray project, certainly for Idaho, to utilize GIS based mapping coupled with a GPS guidance system for the spray aircraft. We were fortunate, as the two counties involved had recently completed GIS based ownership mapping that we were able to incorporate directly into our mapping system. Bennett Lumber of Princeton, Idaho, provided expert GIS mapping assistance for the project. John Ghent, SE Area, Forest Health Protection, detailed to Idaho as an expert in the use of the GPS aircraft guidance systems, and provided excellent assistance. John used a modified version of the GypsEs guidance program used extensively in the east for accurate treatment of gypsy moth populations. Everybody, from the pilots to the landowners, even those who were not especially in favor of the project, was tremendously impressed with the accuracy of the application.

Costs of the projects were borne primarily by the State of Idaho with a 10% cost share for the landowners. Success was determined by measurements of post-spray larval populations, numbers of egg masses, and by measured defoliation at the end of each season. By these measures, the projects were judged to have successfully protected foliage and prevented tree mortality. There were some areas of heavy tree mortality where no treatment was made, either as chosen by the landowner, or in areas of high tussock moth populations missed in the surveys.

Another project that was very enjoyable and that produced great accomplishments was dealing with a mountain pine beetle outbreak in the Stanley Basin, Sawtooth National Recreation Area (SNRA) of South Central Idaho. Private forests within the SNRA were hard hit by the beetle, and when you have only a few trees, the impact is heavy. Management was challenging as there are very strict guidelines pertaining to removal of trees. Special authorization had to be given by the SNRA Management Board to allow the landowners to deal with the problem.

I applied for and received USDA Forest Service, R-1 & R-4 Forest Health Protection cost-share grants for use by the landowners to deal with the problem. A cooperative agreement was developed between the State of Idaho and the US Forest Service that included the assignment of SNRA forester Jim Rineholt as the lead contact person for the work. Basically, Jim became a Private Forestry Specialist for the State of Idaho, but paid by the US Forest Service. This arrangement worked extremely well as Jim was very familiar with the situation, the regulations, and with many of the private landowners. In 2004 the homeowners applied to the State of Idaho for the grants, identifying the bark beetle issues on their lands, developing work and financial plans and indicating how they would provide their share of the expenses, either directly with funds or by in-kind work on the projects. They agreed to remove dead and green infested trees, thin dense stands, apply preventive sprays and/or utilize pheromones (only MCH for DFB) and implement restorative plantings of tree species appropriate for the site. Jim and I worked together, holding many meetings and field trips to educate land owners about how the beetle attacks the trees, providing grant administration, making suggestions for the home owners in making management decisions, helping them find competent contractors for tree removal and tree spraying, and in reforesting affected areas.

Originally, the program concentrated on dealing with the mountain pine beetle and its management in lodgepole stands of the Stanley Basin, expanding into surrounding areas as the outbreak spread. Later MCH preventive treatments for the Douglas-fir beetle were included as this insect was also causing significant mortality. Currently the program reaches as far north as Salmon, Idaho and as far south as Fairfield, Idaho. As of 2008, over $1.5 million of grant funds have helped in 84 projects. Accomplishments through 2008 are shown in the following table. A source of great satisfaction has been the many positive comments received from homeowners and homeowner subdivisions pertaining to the work.

Year	Infested trees removed	Trees sprayed (Carbaryl)	Pheromone pouches deployed (mch)	Acres Thinned	Acres Planted
2004	14,084	7,418	0	0	0
2005	5,709	7,801	1,275	21	3
2006	8,750	17,248	15,968	346	42
2007	719	4,623	29,930	0	0
2008	36	3,461	11,700	0	0
Total	**29,298** (1,275 ac)	**40,551** (1,421 ac)	**58,873** (1,875 ac)	**367**	**45**

Jim Rineholt, Accomplishment Report, 2008

New levels of positive relationships were established between landowners, the US Forest Service, the State of Idaho, local loggers and spray contractors, and local communities. It all turned into a very positive experience. We certainly did our part to stimulate the local economy.

From day one of my career, I participated in annual surveys and in the preparation of reports of conditions. This was one of the requirements attached to the acceptance of federal cost-share funds. A most favorite component was aerial survey, riding in a small Cessna, up and down the canyons, tossed to and fro by the winds, with sharp turns at the end of each canyon to return. All while concentrating on keeping track of where you were, drawing in beetle spots, defoliation boundaries, and tree and insect or disease identification codes. All, without getting deathly air sick. My first flight was in the company of Roody Lood, R-1, Missoula, MT. I sat in the back seat to learn the ropes. What I learned, and learned quickly, was that I was not cut out to be an aerial observer. My stomach could not take such excitement. I should have known it would be tough, as I never could endure carnival rides without getting sick. On that first training flight into the Bitterroot Mountains, I soon found myself lying like a pea-green blob of protoplasm on the back seat, not caring if the whole world was red with dead trees. Roody took pity on me and had the pilot land at a back-country airstrip where I oozed out of the plane and lay in the shade for hours, hoping to once again join the ranks of the living. After years of flying, I found that if I just gritted it out for about three days, I could then continue with the survey work without too much discomfort. Only once did I need the barf bag; that was when I conducted a special survey from the back seat of a paper piper that the State owned. We bounced through the air like a balloon caught in the wind. The pilot forever after apologized for "making me so sick." I do concede though, that if you really want to learn about forest ecosystems and tree species relationships coupled with insect behavior patterns, there is no better way to learn than from the seat of a small survey airplane. I finally did figure out how to meet the challenge though, by assigning Mr. Beckman to do the survey.

Through the years there have been many, surveys, evaluations, control projects and applied research projects. Some of these included the following:

- ►Larch Case bearer: Ground and aerial tests of Orthene®,
- ►Western spruce budworm: Testing of Orthene®, surveys in Southern and Eastern Idaho, Control projects in southwest Idaho using Orthene and Sevin insecticides,
- ►Douglas-fir tussock moth: Testing Sevin-4 oil®, pheromone surveys, treatment projects as mentioned including treating tussock moth within the city limits of Coeur d'Alene, Idaho with Sevin sprayable and Sevimol insecticides,
- ► Western pineshoot borer: Pheromone based control treatments,
- ►Balsam woolly adelgid: Surveys to determine the distribution in Idaho and ground applied pesticide treatment tests. LeRoy Kline, Oregon Dept. of Forestry, invited me to visit the site of an infestation of the balsam woolly adelgid (BWA) that was in the Blue Mountains of Eastern Oregon. I believe this was the first population found in the interior. It is of interest that this area of Oregon is in the direct path of the prevailing winds from the west as they traverse into Idaho, and it appears, bringing this insect with them. We later found heavy populations of the BWA infesting our subalpine fir right in the path of these winds in Idaho. Originally, we only found BWA populations in cool air-drainage subalpine fir in creek bottoms. Here, evaluations conducted by David Beckman, Insect & Disease Technician for the Idaho Dept. of Lands, found that as populations increased from very light to heavy, within five years the trees would die. The low elevation creek-bottom stands of subalpine fir in north-central Idaho have been virtually eliminated by this insect. Later, we also found the insect in high elevation stands, but it did not cause as heavy mortality at these sites as it did in the low elevation creek bottoms. We now have populations from south of the Salmon River to at least Coeur d'Alene, Idaho on the north.
- ►Cone & seed insect treatments at the Moscow White Pine Seed Orchard
- ►Surveys for introduction of exotic beetles
- ►Spruce beetle: One of the larger bark beetle outbreaks was of the spruce beetle in south-central Idaho, near McCall. Wind thrown spruce that went unnoticed for a year or so stimulated a very large outbreak. In 1985 salvage activity was initiated on State Lands. Over 43,287,000 board feet were sold bringing over $6,450,780 ($149/thousand) to the State. At that time, there were no restrictions on selling timber to out-of-state or foreign buyers, and, for one of the sales, the highest bids came from Japan. They wanted the spruce for the construction of musical instruments. That sale brought $804,203 into the state endowment funds, but it also stimulated the forest industry of Idaho to ram a new law through the legislature, the Timber Supply and Stabilization Act, severely limiting out of state sales. They did not like the competition.
- ►Douglas-fir beetle: There have been many surveys, evaluations, management recommendations and projects for the Douglas-fir beetle, some of which have been mentioned. Over all, the Douglas-fir beetle has been the cause of more timber management activity than all the other beetles combined. It has been a constant cause of concern. As mentioned earlier, on State lands we implemented hazard rating techniques and constant vigilance to remove freshly attacked trees, all in a constant effort to minimize losses.
- ►More bark beetles: Pine engraver, mountain pine beetle, western pine beetle, woodborers, and ambrosia beetles. Evaluating populations throughout the state with recommendations for management.
- ►A pine engraver project: Ken Gibson and I had the wonderful idea to see if we could keep the pine engraver from attacking piles of pine slash, as these often serve as sites of population build up. We established that we could readily shut down the attraction of baited funnel traps, but preventing attacks of the slash with pheromone-loaded plastic beads proved elusive. We could see treatment effect, but it would not last. Longer-lasting formulations perhaps might be the answer.

►Pine butterfly: Survey and evaluation of an outbreak in ponderosa pine near Cascade, Idaho where defoliation caused serious tree mortality and subsequent beetle attacks.

►Fire/bark beetle relationships in Douglas-fir and ponderosa pine. In several surveys and evaluations, I found a clear relationship between the build-up of the duff layer, presumably from lack of fire, and resultant damage from even low intensity fires, to the root crowns of trees. Trees were girdled by the fires, then attacked by bark beetles as the trees declined. I observed this in ponderosa pine and Douglas-fir stands in Idaho and in South Dakota.

►Gypsy moth: Another major effort during my career has been working with the gypsy moth. The need for survey work became apparent as the insect was found in neighboring states. Through time, and with cooperative agreements with other State of Idaho agencies, the US Forest Service and the Animal and Plant Health Inspection Service (APHIS), the surveys became more organized, targeted and systematic, covering all urban areas of Idaho. In 1986, we trapped our first moth in Sandpoint, in northern Idaho. After extensive ground surveys we found a well- established population covering a major portion of the city. Later that same year we also found a population in portions of Coeur d'Alene. These finds led to plans and preparations for control projects in both cities using formulations of Bt. One aspect of the preparations was to conduct public meetings. In Sandpoint I had an especially interesting experience. After his retirement, Ron Stark, a former recipient of the Founder's Award and a man of great experience and knowledge, had become a resident of Sandpoint. Ron was well known for his feeling that we should stop spending so much on surveys for the gypsy moth in the west and let it become established, behaving in time, as a native insect. At the public meeting, who should show up, but the ancient professor himself, with a load of books under his arms large enough to nearly require a pack animal to carry them. His implication was that he was the knowledgeable professor, and that I was reacting more like Chicken Little, crying that the sky was falling in. I felt vindicated though, as after considerable discussion and questions, Ron conceded that if something were to be done, at least we were using the correct pesticide and procedures in the project. The treatment projects did go forth, with the populations being declared eradicated after not catching moths in our traps for several years afterwards.

The final chapter of the gypsy moth story in Idaho during my tenure with the State ended on a more serious note. In 2004 we caught one moth in a trap near Hauser Lake, just north of Post Falls, close to the border with Washington. I looked at that moth and felt it had a slightly different look to it, so we sent it for DNA analysis. The results came back that it was an Asian gypsy moth. WOW! Did this cause some excitement! We had more high-level visitors than you could shake a stick at. This was the first time that an Asian moth had been found in the interior, away from a port area. The question was, how did it get there. The only plausible source seemed to be the railroad system, with multiple tracks in the immediate area. Protocol indicated a treatment of one square mile centered on the trap site. All residents within the treatment area were contacted, contracts let, and we proceeded with the project, treating 600 acres with Btk. Once again we utilized a GPS guidance system for the aircraft to assure accurate treatment. As follow up, we increased our pheromone based trapping survey to 25 traps per square mile within a 2-mile radius of the catch site and $16/mi^2$ for the next 3 miles. After three years of not catching more moths, the area was declared to be gypsy moth free.

There have been many other projects of special interest over the years, including the following:

►As mentioned, I participated in the Expanded DFTM RD&A Project, report in Hawaii.

►Participated in the CANUSA - WSBW RD&A project, report in Bangor, Maine.

►Served as a member of the Idaho Governor's committee on Carbon Sequestration on Idaho Agriculture and Forest Lands.

►Served as a member of the Management Team for the US Forest Service, Forest Inventory and Analysis (FIA) Program representing the Western States.

►Member of the Western Defoliator and Western Bark Beetle Steering Committees.

- ►Participated in a team effort to prepare an Assessment and Response to Bark Beetle Outbreaks in the Rocky Mountain Area for Congress, directed by FHP Washington Office.
- ►Team member for a North American Test of Criteria and Indicators for Sustainable Forestry, sponsored by the Center for International Forestry Research (CIFOR) of Indonesia, and the USDA Forest Service. Test was conducted in South West Idaho, hosted by the Boise National Forest, R-4.
- ►Conducted a national survey of Forest Health concerns and Research Needs for the Forest Health Committee of the National Association of State Foresters.
- ►Participant in an American Forests Organization workshop, held in Sun Valley, Idaho, preparing a book on "Assessing Forest Ecosystem Health in the Inland West."
- ►Taught two semesters at the University of Idaho, Moscow, teaching the forest entomology portion of a Forest Health class, receiving very high evaluations from the students. They liked the practical approach to the subject.
- ►Founding member and career-long participant in an Urban Forestry Committee for the City of Coeur d'Alene, Idaho, serving for several years as chairman. We developed guidelines, statutes and code for the Urban Forests of the city.
- ►Served many years as the secretary/treasurer, then treasurer for this organization, the Western Forest Insect Work Conference. I would like to pay tribute to all those that have served and given of their time through many years to this organization. It is a wonderful forum for education, for discussion and sharing of information, support of students with opportunities for papers and scholarships, and support of each other, for friendship, and just plain good times. With our long history, all of the committees, and those who serve for each meeting, it all makes for the best organization of all.

I would also like to recognize several people whose support and cooperation have contributed greatly to the success of the Forest Health program for the State of Idaho:

Dewey Almas, my first Supervisor, who provided encouragement and freedom in the work.

David Beckman, Technician in the IDL FHP Program. Originally hired to work with Mal Furniss, continuing as a permanent employee. A constant source of support and hard work.

Bill Ciesla, as FHP program leader for R-1, Missoula, Montana, played a significant role in the establishment of the Idaho Program. Bill provided continuing support and suggestions as the program developed.

Jed Dewey, FHP Program Manager for many years in Missoula, was a constant source of support and guidance.

Rick Johnsey, Washington, DNR. Rick hired me to survey for European pineshoot borer and later we cooperated on common insect populations.

LeRoy Kline, Oregon Dept of Forestry. Friend & mentor; helped with Douglas-fir tussock moth and balsam woolly adelgid.

Steve Kohler, Montana Dept. of Fire & Forestry. We worked together in the cooperative hiring of a forest pathologist that worked half time for each state.

Greg Denitto (R1, Missoula) **Dayle Bennett** (R4, Boise) **Jill Wilson** (R1, Coeur d'Alene), **Jim Byler** (R1, Coeur d'Alene). All FHP Program Managers who provided assistance in obtaining project funds, and in general support.

Steve Munson, FHP, R4, Ogden. Entomologist and Program Manager. A friend and supporter with many ideas and support.

Ken Gibson, FHP Entomologist, Missoula, Mt, a friend who has been a constant source of ideas, support, and cooperation.

Sandy Kegley, FHP Entomologist, Coeur d'Alene, with whom I have enjoyed many discussions and projects, and to whom I owe the honor of having been nominated for the Founder's Award. Thank you Sandy!

In closing, I would like to share a few lines that show that the study of beetles in trees has been around for a good while:

Found in a book by Cort Conley **"Idaho Loners: Hermits, Solitaires, and Individualists"**
A few lines from a poem entitled "Hermits" by James Galvin.

"In wet years the land breathes out,
And a crop of limber pines jumps into the open
Like green pioneers.

In dry years
Beetles kill them with roadmaps
Under the skin."

Finally, to help keep ourselves in proper perspective as forest entomologists, here is a quote from Ken Gibson, illustrated by Dewey Almas, Ladd's first supervisor with the Idaho Department of Lands:

If a forest entomologist is walking in the woods,
and a tree falls on him,

Drawings by Dewey P. Almas (February, 2009)

Does anybody care?

FIELD TRIP

Hosts: Mike Johnson and Darci Carlson

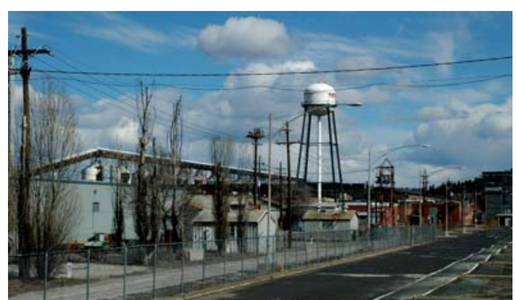
The field trip included three stops that complemented the theme of the conference; "Some Like It Hot; Insects, Fire, & Climate Change in Western Forests". In addition, a historic perspective was provided at each stop.

Mike Johnson and Darci Carlson introduce the field trip topics in the snow. Dishman Hills, Spokane, Washington

Fire (wind driven)

Buses left the historic Davenport Hotel for the first stop at Dishman Hills; the site of the 2008 Valley View Fire. In route, participants enjoyed their lunches and watched a video presentation on the Valley View Fire. Gathering at the ball field of the gated neighborhood where damage from the fire was still evident, Mike Johnson gave a historical perspective relating the role that Spokane performed during the fires of 1910. The community served as a staging area for the military dispatched to help fight the fires. In addition, Spokane was a source of fire fighting tools, food, medical supplies, and medical treatment for injured firefighters. Spokane also functioned as a source of labor to fight the fires: "stew bums", men who frequented pool halls, and the men who wore caps instead of hats. Mike also addressed the role of "palousers"; winds that blew in from the southwest across the Palouse Hills and fanned the fires of 1910. Art Zack reinforced the point with large scale maps he shared with the group of the "Big Blowup" of 1910 that clearly exhibited the characteristic (wind driven) appearance of those fires. During the presentation, wind blew in from the southwest, shifted direction, and delivered snow and hail on the participants further underscoring its role as an agent of disturbance.

Steve Harris, Landowner Assistance Program Manager, and Guy Gifford, Fire Prevention Forester, both with the Washington State DNR, Northeast Region, were the guest presenters at this stop. Steve and Guy related their experiences fighting more recent wind driven fires in the Dishman Hills in 1985, 1991, and again in 2008. They shared maps displaying the pattern of wind driven fires that have occurred over the years at this location similar to what was seen in 1910. While the ignition sources and the weather patterns have remained the same before and since 1910, the increased number of people inhabiting the Dishman Hills area has increased the difficulty and complexity of fighting fire. Steve related successes with fuel reduction and cost share efforts in the area employed to address that issue.



Don Alstad (at the Mead Works)

Insects

The second stop convened at the Kaiser Aluminum Plant (no longer in operation) at Mead. Steve Harris explained that this plant played a crucial role in the war effort; providing aluminum for aircraft. Mike Johnson provided spatial context, displaying a map indicating the location of the plant in the Hillyard Trough of the Spokane Rathdrum Aquifer. Mike provided additional historical perspective explaining that ALCOA, which operated the plant in the early 1950's, brought in Dr. George Edmunds who conducted initial investigations on

Photos: (L to R) Black pineleaf scale causes tree crown to have a "lion's tail" appearance; infested needles; BPLS damaged ponderosa pine from a distance.

black pineleaf scale (BPLS). Decades of research on BPLS followed in the Hillyard Trough principally by our guest speaker, Dr. Donald Alstad who was mentored by, and worked with, Dr. Edmunds. Don discussed previous research results related to the affect of landform and air temperature on BPLS populations in the Hillyard Trough/Little Spokane River Arm. Don, who conducted extensive research on BPLS in the greater Spokane area, particularly related to local intrinsic natural adaptation, also fielded questions on his research associated with this topic. One particular inquiry resulted in a rather lengthy response that ended with Don commenting, "That was a long answer to a short question"; followed by laughter from the audience. Participants were able to examine samples of ponderosa pine foliage they were provided from a BPLS outbreak southeast of Cheney, WA that was infested with BPLS and exhibited characteristic damage: chlorosis and necrosis. Don offered descriptive information regarding the host material and the BPLS specimens that participants were given. A man who clearly loves his work, Don's enthusiasm was infectious and it was a pleasure to have him join us.

Climate change?

Our third stop was located on the rim overlooking Riverside State Park. Mike Johnson related how, prior to European settlement, people of various cultures used the surrounding area, particularly at the confluence of the Spokane River and the Little Spokane River, as a gathering place to fish and dry/smoke their catch for winter provisions. These gatherings also provided opportunities to hunt and trap. People engaged in additional activities that included visiting with friends and relatives from neighboring or distant tribes, trading, gambling, racing, courting, and dancing.

By the early 1800s David Thompson, working with the Northwest Company, explored, surveyed, and mapped the Columbia River and its tributaries helping to open up the region to beaver trapping, trade, and settlement. Mike identified the routes that David Thompson traveled on a facsimile of one of the maps that Thompson produced. Thompson charged Jaco Finlay with the establishment of Spokane House, a trading post, located just 10 miles further downstream from our location in a "fine pine flat" near the confluence of the Spokane River and the Little Spokane River. Mike discussed the merger of the fur trading companies and the relocation to Kettle Falls.

Our guest speaker at this stop was Gary Vierra, Assistant Park Manager, with Riverside State Park. Gary addressed the challenges of managing the park in the face of a **changing** social and political **climate**. Tying into the topic at the first stop, Gary discussed the threat from fire, which had impacted the park in the recent past and the need for silvicultural treatments to mitigate potential adverse effects from that disturbance in the future. Gary also spoke to the need to thin the stands of trees to improve their vigor, resiliency and resistance to bark beetles and other pests. However, Gary also expressed concern about the lack of funding to implement those treatments, particularly in view of the current economic downturn and loss of markets. At that point, Steve Harris informed the crowd that he had submitted a grant proposal for money to implement fuel reduction activities and that Gary would be eligible to apply for that money. Then Karen Ripley announced to the group that she had requested cost-share funding for State Parks planning and management activities. Gary was clearly moved by the efforts of Steve and Karen on his behalf. A lively discussion ensued regarding the need to adapt to changing markets.

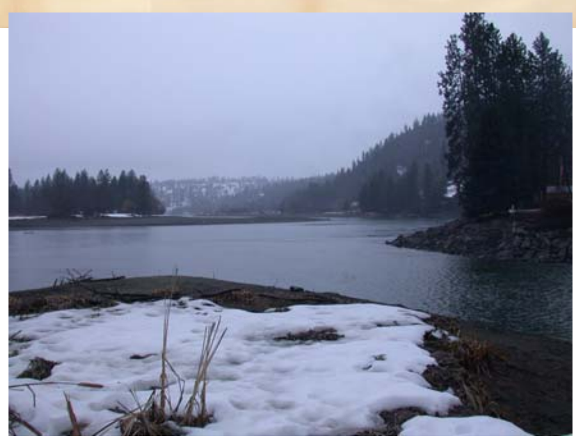
Wrapping up the field trip, names were drawn and the winners given books on David Thompson and on the great fires of 1910. The speakers were thanked for their contributions and the group was shuttled back to the Davenport Hotel.

(Above) Riverside State Park, Spokane, WA

(Right)
Map by David Thompson
(Courtesy: The Edmonton Region Green Atlas Society)

(Below Left) Spokane House Interpretive Center

(Below Right)
Confluence of the Spokane River (left) and the Little Spokane River (right)



PLENARY SESSION I: PERSPECTIVES ON THE 1910 FIRES

The Fires of 1910: An Historical Overview

Sarah Wilson, Zone Archeologist, Idaho Panhandle National Forest

Despite the winter of 1909-1910 being a heavy one, the spring and early summer in 1910 were extremely dry. The residual moisture and snow pack were gone early in the season. It was the driest summer many could remember. Commerce at the time was focused on mining, logging and railroad building. These activities left large amounts of fuel down on the dry forest floor. At the time, the Forest Service was a brand new agency, having been started just 4 years prior. While some forests had experience fighting fire, there were not nearly enough people on hand, and there was no reserve equipment available that could have prepared the agency for a season like 1910. By early August, President Taft realized that the situation was out of control and authorized the army for firefighting.

On August 10th, high winds and low humidity caused the fire behavior to become more extreme. A wave of fire crossed into Montana from the Bitterroot Range. This run scattered spot fires, and wreaked havoc on the fire lines crews had dug. This was a precursor to what was coming later that month. By August 15th, over 3000 small fires, and 90 large ones had been controlled by the fire-fighting efforts, and the men working as firefighters were exhausted. After the first blow up on the 10th, more crews were put out to respond, and they were successful in getting the situation under control. On August 19th, things were looking good, and fire-lines were holding.

On August 20th, a gale force wind blew for 2 days. This caused the fire behavior to explode. One observer said that the air felt electric, as though the whole world was about to go up on spontaneous combustion. The fire raged past towns, a third of Wallace, Idaho was in ashes by the evening of the 20th. People were shuttled on trains out of town, and taken to safer places like Missoula and Spokane.

The Fires of 1910 brought out the character of many strong leaders, who in a time of crisis held it together and did their best to save their crews. Some of the best known crew leaders are William Rock, Joe Halm, and Edward Pulaski. When the winds picked up on the 20th, William Rock led his crew to a place that had burned the day before, a decision that saved every one of them. Joe Halm held his crew together by having them lie in the creek and cover themselves and their gear with wet blankets. He told them "not a man leaves this camp. We'll stay by this creek and live to tell about it. I'll see you through ..." All of them survived. The most well known story of the 1910 fires is that of "Big Ed" Pulaski, the man who later invented the popular firefighting tool – The Pulaski. Ed Pulaski and his crew were heading to Wallace when he realized the fire was coming at them from both sides. Pulaski knew of a mine tunnel and headed there. He reportedly held the panicking crew at gun point to keep them in the tunnel and safe. Today Pulaski's escapeway and tunnel is listed on the National Register of Historic Places. It is a popular historical hiking trail just outside of Wallace.

Nicholson Adit (where Ed Pulaski held his crew)

The fire was devastating to the people who lived through it. Communities were initially impacted by the immediate loss of life, homes, and businesses and people were shaken to the core. Homes and towns were replaced by tent cities before they could be rebuilt.

After the Fires, there were acres and acres of killed timber. Millions of board feet of timber were slated to be salvaged. This salvaging operation lasted into the 1920's and helped to revive the devastated economy.

Ecology, Before and After the Fire
Art Zack, Ecologist/Silviculturist,
Idaho Panhandle National Forest

No summary provided.

GRADUATE STUDENT PRESENTATIONS

Session 1: Ecological. Andris Eglitis, Moderator

Examining the relationship between host monoterpenes and Douglas-fir tussock moth

Amy Carroll, University of Idaho

Stands were silviculturally treated (thinned and fertilized) in an attempt to increase tree resistance to Douglas-fir tussock moth. Results were compared with laboratory bioassays that examined the toxicity of five monoterpenes present in Douglas-fir to immature tussock moth.

The Characteristics of Ponderosa Pine Associated with Attack by the Roundheaded Pine Beetle

Melissa Joy Fischer and Kristen M. Waring
Northern Arizona University, Flagstaff, Arizona

Dendroctonus adjunctus is an aggressive bark beetle species that attacks several species of pine throughout its range from southern Utah and Colorado south to Guatemala. A current outbreak of *D. adjunctus* provided a unique opportunity to study the relationship between this beetle and the characteristics of ponderosa pine chosen for attack in northern Arizona. We examined the growth rates, physical characteristics and resin composition of trees that had been attacked by *D. adjunctus* compared with unattacked trees. We found significant differences in basal area increment, internode lengths of branches and subbranches, subbranch length, needle length, phloem thickness and resin composition. Attacked trees had significantly slower growth in basal area increment, internode lengths and needle lengths, but had longer subbranch lengths in the top of the crown. Attacked trees also had thicker phloem and contained significantly higher percentages of α-pinene, but lower levels of longifolene when compared to unattacked trees. Our results suggest that *D. adjunctus* chooses specific trees within the stand to attack, but the mechanism for this choice is unknown.

Some surprising results when two isolates of a mountain pine beetle symbiotic fungus are tested on the same or different trees

David Jack, John McLean, Colette Breuil, Gordon Weetman
Faculty of Forestry, University of British, Vancouver BC, Canada

Can nitrogen fertilizer increase the natural defense of mature lodgepole pine trees against mountain pine beetle (MPB) attack? To help answer this question a study site was established in BC's Southern Interior in a 160 year old mixed species forest. In the summer of 2006, thirty 40m^2 plots were established. Foliar analysis was used to determine the appropriate fertilizer treatments: control (no treatment), 200kgN/ha (recommended treatment), and 400kgN/ha (2x treatment). As a result 4856 lodgepole pine, 2162 subalpine fir, and 1029 interior spruce trees are being monitored within these plots.

One tool we have used to look at responses to the fertilization is the trees dynamic wound response (DWR) to inoculations with a MPB-associated bluestain fungus. We have been using two isolates of *Grosmannia clavigera* for this test. First year post fertilization (2007) DWR results showed high tree to tree variability and no significant fertilizer treatment effect. In an effort to reduce this natural variability we inoculated the two fungal isolates into the same trees in the second year post fertilizer treatment (2008). Decreased lesion lengths were associated with higher fertilizer treatment for each isolate. A surprising result though was that the less aggressive isolate of *G. clavigera* had much longer lesions in 2008, almost as long as the aggressive isolate. This contrasts markedly with the results from 2007 when the two isolates were inoculated into separate trees. Lab and DNA analysis in 2008 showed that each isolate was contained separately in unique lesions with no indication of fungi outside the lesion areas. This surprising result of independent inoculations of fungi affecting each other is now being further investigated.

The frass is always greener on the other side of the fence: Evidence of reduced natural enemy assemblages for mountain pine beetle that colonize spruce vs. pine

Fraser McKee, Dezene P.W. Huber, and Brian H. Aukema,
University of Northern British Columbia

Within the central interior of British Columbia, mountain pine beetle (*Dendroctonus ponderosae* Hopkins) (Coleoptera: Scolytidae) are attacking interior hybrid spruce (*Picea glauca* x *engelmannii*) with increasing frequency, in some cases leading to successful colonization and reproduction. While effort has been undertaken to understand interactions between mountain pine beetle and its associated natural enemies (ie. predators and competitors) in lodgepole (*Pinus contorta* var. *latifolia*) and other *Pinus* hosts, little is known about these relationships within "unusual" hosts such as *Picea* spp. This study examines the attraction and reproduction of mountain pine beetle and associated natural enemies in interior hybrid spruce vs. lodgepole pine hosts in the presence and absence of female colonizing mountain pine beetle. Results of this study indicate that pine logs were equally attractive as spruce logs to dispersing mountain pine beetle when colonizing females were present. Alternately, pine logs were highly favoured when compared to spruce logs with respect to host attraction by potential competitors *Ips pini* (Say), *Pseudips mexicanus* (Hopkins), and *Orthotomicus latidens* (LeConte). Further, brood production by these potential competitors within pine logs was much higher when compared to spruce. Spruce logs supported almost no successful competitor brood production. Brood production by mountain pine beetle was greater in pine logs, on average, relative to spruce logs. However, instances occurred when brood production within spruce was greater than the average rates found in pine. Results indicate that although spruce hosts may be less suitable for mountain pine beetle reproduction on average, reproduction within spruce appears to occur with very little resource competition by the competitor species that were able to be analyzed during this study.

Patterns of resource acquisition between fungal symbionts isolated from four bark beetle populations

Seth Davis, Northern Arizona University

Trait-mediated indirect interactions between species are rarely considered in the context of obligate mutualism. We investigated patterns of primary and secondary resource acquisition between allopatric and sympatric strains of mutualistic fungi associated with the scolytid beetles *Dendroctonus frontalis* Zimmerman and *Dendroctonus brevicomis* LeConte. Growth assays at multiple temperatures suggest that patterns of primary resource acquisition by fungal strains vary between but not within beetle populations. In competition assays, fungal mutualists isolated from zones where host beetles occur in sympatry were stronger competitors in a resource limited environment than fungal mutualists isolated from allopatric host beetle populations. We combined the results of both assays as covariates in a principal components analysis to assess segregation of fungal strains by patterns of primary and secondary resource acquisition. Principal components discriminated sympatric mutualist fungi by secondary resource acquisition in sympatric beetle populations and by primary resource acquisition across sympatric and allopatric populations. Furthermore, this analysis is among the first to demonstrate that the continuous, relative scoring of interactions can be useful in delineating competitive communities. In a broader context, these results suggest that variable resource acquisition patterns between the obligate mutualists of sympatric herbivore species might limit displacement among competing herbivores.

Student Session 2: Technological. Rob Flowers, Moderator

Take Me to Your Leader: Does Early Successional Non-host Vegetation Spatially Inhibit *Pissodes strobi* (Coleoptera: Curculionidae)?

Jordan M. Koopmans,[1] Honey-Marie C. de la Giroday,[1,2] B. Staffan Lindgren,[1] and Brian H. Aukema[1,2]
[1]University of Northern British Columbia; [2]Natural Resources Canada, Canadian Forest Service, 3333 University Way, Prince George, British Columbia V2N 4Z9, CANADA

The spatial influences of host and non-host trees and shrubs on the colonization patterns of white pine weevil *Pissodes strobi* (Peck) were studied within a stand of twelve-year-old planted interior hybrid spruce (*Picea glauca* [Moench] Voss × *Picea engelmannii* [Parry] ex Engelm.). We surveyed greater than one-thousand trees. Planted spruce accounted for one-third of all trees within the stand. The remaining two-thirds were comprised of early-successional non-host vegetation, such as alder (*Alnus* sp.), birch (*Betula* sp.), black cottonwood (*Populus balsamifera* ssp. *trichocarpa* [T. Ng.] Brayshaw), lodgepole pine (*Pinus contorta* [Dougl.] ex Loud.), trembling aspen (*Populus tremeloides* Michx), willow, (*Salix* sp.), and Canadian buffaloberry (*Shepherdia canadensis* [L.] Nutt.). Spatial point process models demonstrated that Canadian buffaloberry, birch, black cottonwood, and trembling aspen had significant negative associations with weevil abundance, even though the density of the insects' hosts in these areas did not change. Furthermore, knowing the locations of these non-host trees provided as much, or more, inference about the locations of weevil-attacked trees as knowing the locations of suitable or preferred host trees (i.e., those larger in size). Non-host volatiles, the alteration of soil composition, and overstory shade are discussed as potential explanatory factors for the patterns observed. New research avenues are suggested to determine if non-host vegetation in early successional stands might be an additional tool in the management of these insects in commercially important forests.

New developments and rediscoveries in the quest to identify spruce budworm species in western North America

Lisa Lumley and Felix Sperling, University of Alberta

The taxonomy and relationships of species within the spruce budworm complex remain unresolved in spite of the enormous importance of this group. Through mitochondrial DNA, microsatellite markers, and morphometrics, we have developed an integrative approach to species delimitation. Recent work with microsatellite markers indicates that they will also be useful in finer-scaled population genetics studies. This presentation focused on our research findings in western North America.

Invasion of the Peace River Region of British Columbia by *Dendroctonus ponderosae*: What do infestation patterns tell us about dominant dispersal mechanisms?

Honey-Marie de la Giroday, University of Northern British Columbia

During the initial spread of mountain pine beetle over the historic geoclimatic barrier of the Rocky Mountains into the Peace River region of British Columbia between 2004 and 2006, there existed various anecdotes explaining the movement of the insect into the region. Potential dispersal modes included aerial dispersal of the insect *en masse* from large populations west of the Rocky Mountains, introduction via transport and storage of infested logs during harvesting by licensees, and ground movement of the insect along linear features, such as rivers, perhaps providing milder microclimates as well as habitat for suitable hosts. We evaluated annual inventories of mountain pine beetle populations relative to patterns of spread associated with hypothesized dispersal mechanisms and anthropogenic features, including sawmill sites and roads using spatial point process regression models. Our results indicate that long-distance aerial transport and deposition is the most plausible mechanism.

Improvement of forest inventory variable estimates with ancillary data supplied by multi-source high-spatial resolution remotely sensed data

Sam Coggins, University of British Columbia

Estimates of low level mountain pine beetle attack are difficult to obtain from a single remotely sensed image because the level of detail and extent of images differs between image types. This research will provide methodologies to scale between image types to provide estimates of the area affected by mountain pine beetle infestations and will provide individual tree estimates over large areas.

Occurrence of mountain pine beetle infestations in western Canada: Impact of effective temperature, elevation, and past infestations

Kishan R. Sambaraju[1], Allan L. Carroll[2], Jun Zhu[3], and Brian H. Aukema[1, 4]
[1]University of Northern British Columbia, Prince George, BC, Canada; [2]Natural Resources Canada-Canadian Forestry Service, Pacific Forestry Centre, Victoria, BC, Canada; [3]Department of Statistics, University of Wisconsin, Madison, WI, USA; [4]Natural Resources Canada-Canadian Forestry Service, Pacific Forestry Centre, Prince George, BC, Canada

The mountain pine beetle, *Dendroctonus ponderosae* Hopkins (Coleoptera: Curculionidae), has been a destructive pest of lodgepole pine in British Columbia, Canada, especially during the past decade. This important insect has been spreading eastward toward Alberta with a potential to further extend its range into the boreal pine forests of Alberta and beyond. Climatic and spatiotemporal factors can affect the occurrence and spread of mountain pine beetle. Developing statistical models based on these factors and assessing their contribution to mountain pine beetle spread may help in predicting future infestations which in turn may facilitate management decisions by forest managers. In this ongoing study, we studied the effects of several interpolated temperature variables, elevation, and past infestations on the occurrence of mountain pine beetle over a large geographical area in western Canada. The impact of these factors on the probability of finding an infestation was studied using logistic regression. Results of the analysis showed that the outbreak probability per unique study area was highly influenced by the presence of past infestations. Temperatures below -40ºC during winter or above 40ºC during summer and higher than average July-August temperatures decreased the outbreak probability. This ongoing model analysis will be further improved by including an appropriate spatial neighbourhood structure and correcting for spatio-temporal autocorrelations.

CONCURRENT WORKSHOP I:
Are Current Insect Outbreaks Unprecedented? What Can History Tell Us?

Moderated by Sandy Kegley, USDA Forest Service, Northern Region

Insect outbreaks, especially bark beetle outbreaks, have recently been making the news. Some articles mention that current outbreaks are "unprecedented" and a warming climate is to blame. How do we know this? It is difficult to compare current outbreaks with historic outbreaks for several reasons. There are few, if any, eyewitnesses available to recall the extent of historic outbreaks; recorded history is relatively short; and the methods used to quantify historic and current outbreaks are different. We have the luxury today of being able to view wide expanses of the west by airplane and quantify tree mortality using aerial surveys. The first aerial survey was conducted by Tom Terrell in 1930 but forests weren't routinely surveyed by air until sometime in the 1970's. Even so, aerial survey data indicate that mountain pine beetle outbreaks in the western United States in the late 1970's and early 1980's covered more acres than our current outbreaks (fig. 1).

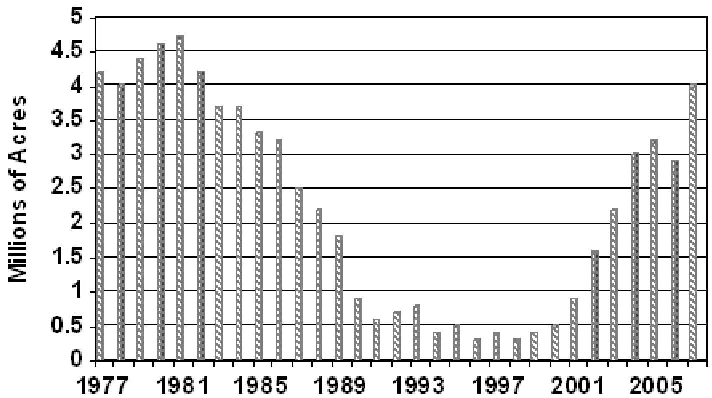


Figure 1. Acres infested by mountain pine beetle in the western U.S from aerial survey data. Data compiled by Ken Gibson from National Conditions Reports.

There are some historic reports from the early 1900's but many have been lost or forgotten. Where they do exist, outbreaks are often described qualitatively or are not quantified the same as today. In some instances, we may have to interpret historic conditions from anecdotal evidence. For example, in 1934, Yellowstone National Park rangers concluded "The mountain pine beetle epidemic is threatening all of the whitebark and lodgepole pine stands in Yellowstone Park. Practically every stand of whitebark is heavily infested and will be swept clean in a few years". At the same time, extensive whitebark pine forests were being killed in central Idaho (Furniss and Renkin 2003). There was obviously a large outbreak going on but its extent was not quantified. All this makes the question of precedence a difficult one to address. However, there are some studies that have used dendrochronology to date and measure previous outbreaks in local areas. We must also remember that outbreaks occur in forests with certain characteristics. Current outbreaks may be more a result of increased forest susceptibility due to stand age, structure, and species composition than warming temperatures alone. Four speakers were asked to address historic outbreaks from their respective local areas and provide evidence that current outbreaks may or may not be "unprecedented". Summaries from each presenter follow.

Literature Cited

Furniss, M.M. and Renkin, R. 2003. Forest Entomology in Yellowstone National Park, 1923-1957: A Time of Discovery and Learning to Let Live. American Entomologist. Winter 2003, p. 198-209.

Mountain Pine Beetle Outbreaks in Whitebark Pine in the 1930s in Central Idaho

Dana L. Perkins, PhD. Ecologist, Bureau of Land Management, Challis Field Office

Basal area and trees per acre of whitebark pine killed by mountain pine beetle were compared between a historic (ca. 1930) epidemic and the current (ca. 2000) epidemic. Plots from six stands that were attacked in the 1930's (Perkins and Roberts, 2003) were re-measured and compared with 2008 stand metrics. Of these six stands, four stands had greater basal area and trees per acre killed in the 1930's than in the current epidemic, one stand had the reverse, more killed in the current epidemic than the 1930's, and two stands had approximately the same amount of mortality. For *some* susceptible stands in central

Idaho, this provides evidence that the mass of trees killed historically was as great as or greater than the amount killed currently.

Plots from four stands that were *not* attacked in the 1930's are currently experiencing tree mortality from the current mountain pine beetle outbreak. Most of these stands were young in the 1930's and did not have susceptible stand structure characteristics (large diameter trees) until now.

Reference:
Perkins, D. L. and D. W. Roberts, 2003. Predictive Models of whitebark pine mortality from mountain pine beetle. Forest Ecology and Management. 174:495-510.

Historic Outbreaks in the Black Hills

Bill Schaupp, USDA Forest Service, Rocky Mountain Region

Euro-American settlement began after the discovery of gold in 1874 in the Black Hills, an island mountain range rising over 1,000 m above the northern Great Plains of southwestern South Dakota and northeastern Wyoming, USA. Starting in that year, we have a continuous record of mountain pine beetle outbreaks, as well as photographs showing forest conditions. Isolated both by geologic time and distance from conspecifics, after settlement these ponderosa pine forests came under the influence of surface fire suppression and intensive timber harvest. Forest structure has become less diverse and variable, with an increase in the number and expanse of denser stands containing less large diameter pine.
Despite changes in forest structure and land use patterns, by far the most intense and extensive outbreak since 1874 was the first one, occurring in the late 1890's to early 1900's (fig. 2). Clearly a large portion of the Black Hills reached a highly susceptible condition independent of Euro-American influence. Mortality from this initial beetle outbreak and human activity was so significant that it was decades before another outbreak was possible. Subsequent outbreaks were not consistently associated with periods of below average precipitation or above average fire occurrence. Given sufficient diameter, it is stand and forest conditions that best explain the observed outbreak pattern to date. Probability of infestation and estimated mortality are positively correlated with higher stand density and dense stand distribution across the Black Hills.

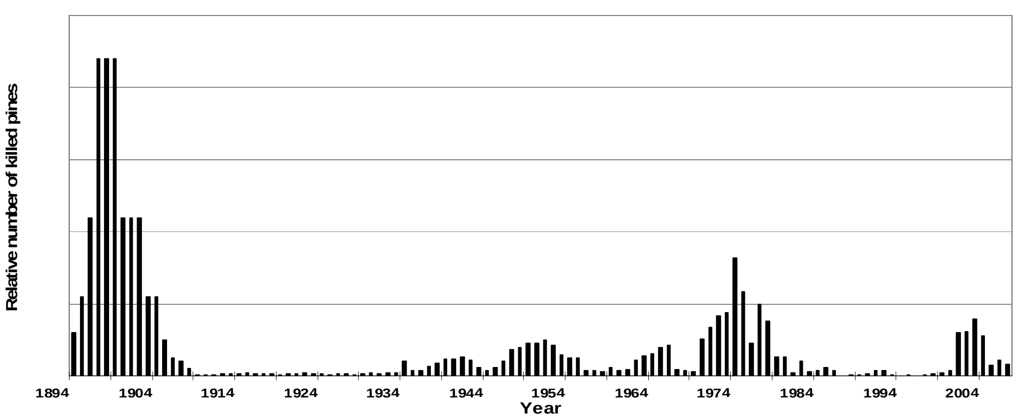


Figure 2. Relative number of killed pines in the black hills from 1894-2007.

What does history teach us? First of all, to be mindful that we have not much history, about one generation of pine since the mountain pine beetle was described from Black Hills specimens, so the "outbreak book" is still being written. The current outbreak is not unprecedented, being well within "historic" range. Of interest is the question of how the Black Hills forest became susceptible starting sometime in the 18th Century. Of concern is what the mountain pine beetle has in store for us in the future.

Disturbance, host age, and bark beetle outbreak dynamics in British Columbia

Steve Taylor, Allan Carroll and Greg Smith - Canadian Forest Service, Pacific Forestry Centre

This talk reviews a preliminary look at risk modeling examining the age distribution of hosts of the four major bark beetle species of British Columbia and how that distribution has changed over the past 100 years. From data collected by the Forest Insect and Disease Survey and the BC Ministry of Forests and Range, it appears that bark beetle outbreaks have been increasing in size within BC since the 1930's, especially the mountain pine beetle (*Dendroctonus ponderosae*) and the western balsam bark beetle (*Dryocoetes confusus*). Although outbreaks are increasing in extent, beetles are not using the full range of their hosts. This brings about two questions: 1) Have past climate and host suitability limited historic outbreaks? and 2) Have changing disturbance regimes influenced host dynamics? To answer these questions, a simple population model was constructed to forecast and "backcast" host age dynamics between 1920-2000. The model used estimations of current age distribution in 20-year classes from forest inventory data and estimated historical depletions (wildfire and logging during 20-year periods by host species) while assuming disturbances were stand replacing and host species self-replacing.

This modeling suggests that, because the overall disturbance rate (fire and harvesting) has decreased, forests in interior BC are generally older than 80 years ago and as a result, resource availability has increased for the four bark beetles studied. This is most pronounced for lodgepole pine and mountain pine beetle. While there are substantial increases in the amount of older aged spruce and Douglas-fir, other factors, such as amount of dead downed trees are also important in initiating those outbreaks. With the addition of the Safranyik climatic suitability model, climatic suitability and pine susceptibility (age) increase over time for the mountain pine beetle. Additionally, using the Hansen-Bentz spruce beetle voltinism model, it appears that spruce beetle in BC will shift from semi-voltine to univoltine over much of its range in the near future.

From this work, three conclusions can be drawn. 1) Changing disturbance regimes (rate, age specificity, size) alters host age structure and contiguity. Forests in B.C. are in a transitional state from an unmanaged condition regulated by natural disturbances to a condition regulated by harvesting. 2) Past forest disturbances impart an "ecological memory" on host age patterns. We cannot alter forest age structure over large areas very quickly. 3) Host dynamics are the most predictable component of the host/climate/insect population system. We need to better incorporate host susceptibility X climatic suitability in forest planning models at multiple-scales.

Historic Spruce Beetle (Coleoptera: Curculionidae) Outbreaks and Climate

Elizabeth G. Hebertson, Forest Health Protection, Intermountain Region

This presentation was based on research previously published in the paper, *Hebertson, E.G., and Jenkins, M.J. 2008. Climate factors associated with historic spruce beetle (Coleoptera: Curculionidae) outbreaks in Utah and Colorado. Environmental Entomology 37(2): 281-292.* The purpose of this research was to explore potential relationships between climate factors and historic spruce beetle outbreaks that were reported in Utah and Colorado, USA, between 1905 and 1996. The results of classification and regression tree analysis indicated that historic outbreak years were generally related to warm fall and winter temperatures and drought. The lack of historic stand attribute data, climate data, and documentation makes it difficult to determine whether recent spruce beetles outbreaks are unprecedented compared with historic outbreaks. However, these results suggest that predicted temperature increases may contribute to the success of spruce beetle populations and the potential for outbreaks.

WHERE ARE WE AND HOW DID WE GET HERE?
FOREST INSECT CONDITIONS IN THE WEST
Moderator: Ken Gibson

Bark beetle Conditions in Western North America

Carl L. Jorgensen, USDA Forest Service, Forest Health Protection, Boise, ID.

In 2008, warm and dry conditions continued to be a contributing factor for bark beetle activity in western North America and the southern United States.

Mountain pine beetle, *Dendroctonus ponderosae* Hopkins (MPB), continued to be the dominant bark beetle causing tree mortality in western North America, in 2008. In British Columbia, MPB affected over 7.8 million hectares, a decrease of about 2 million hectares from 2007. A total of 13.5 million hectares have been affected in the current outbreak. MPB infestations have extended into Alberta in LPP and LPP/jack pine hybrids, although those outbreaks to date are light and scattered. In WA and OR, MPB activity was still at high levels (>840,000 acres in Pacific Northwest Region), but was less than outbreaks in the 1980s. As elsewhere in the West, MPB activity in MT, ID, WY, UT, CO, and SD continued at high to extreme levels. In the Northern Region, more than one million acres have been infested, but was still less than levels recorded in 1981. Many areas have experienced depletion of susceptible hosts and MPB populations have begun to decline. In southwestern white pine, MPB activity was recorded for the first time on the Apache-Stigreaves National Forest (NF) and only the second time in the Pineleno Mountains of AZ.

In pine stands of CA, MPB, Jeffery pine beetle *D. jeffreyi* Hopkins (JPB), and western pine beetle *D. brevicomis* LeConte (WPB), were active in the southern Cascades, Sierra Nevada and other southern CA mountain ranges on small groups or individual trees. Bark beetle populations are expected to increase if drought conditions persist, because many stands are already highly susceptible to bark beetles. Of note, the largest known sugar pine on the Stanislaus NF was killed by WPB in 2008.

WPB, and several species of pine engravers (*Ips* spp.) were active in scattered ponderosa pine stands in WA, OR, ID and MT (WPB is not found in eastern MT—from Continental Divide eastward, engraver beetles and MPB killed most PP). On the Gila NF in AZ, bark beetle-caused mortality increased—some was associated with recent fires.

In Alaska, spruce beetle *D. rufipennis* (Kirby) (SB) activity was down from 2007; however, *Ips pertubatus* activity was up with recent warming and wildfires in the Interior. SB was also active in north-central WA, southwestern CO, central UT and near the Cathedral and Quensel Lakes areas in BC.

Douglas-fir beetle *D. pseudotsugae* Hopkins (DFB) infestations were scattered across western North America but not at extremely high levels. A few stands experienced more intense mortality, often associated with recent blowdown, previous defoliation or other disturbances—notably wildfires. North-central WA, northern coast of OR, central UT, western CO, northern and central ID and northwestern MT had notable infestations, although in many areas at continued declining levels. DFB infestations in AZ and NM had also declined.

Notable western balsam bark beetle *Dryocoetes confusus* Swaine (WBBB) activity was reported in MT, central UT, WY, and CO. Most activity was in subalpine fir stands where WBBB acts as part of a decline "complex," or directly as a primary mortality agent. In AZ and NM, corkbark fir continues to be significantly impacted—almost exclusively by WBBB.

Miscellaneous bark beetles: Fir engraver beetle (*Scolytus ventralis* LeConte) activity was higher than normal in northern ID and common in central CA, especially in overstocked stands where root diseases were prevalent. Eastern larch bark beetle *D. simplex* LeConte investigations continued in Alaska. Silver fir beetle *Pseudohylesinus sericeus* Mannerheim populations increased slightly in WA and OR. Across southeastern U.S., southern pine beetle *D. frontalis* Zimmerman was at historically low levels in 2008. Relatively little bark beetle-caused pinyon pine mortality was reported.

The Western Bark Beetle Research Group is requesting comments and/or suggestions for future research and development needs. Many in that group were not able to attend WFIWC this year.

Defoliating Insects in the West.

Sheryl Costello, USDA Forest Service, Forest Health Protection, Golden, CO.

A 2008 West-wide summary of defoliating insect activity was presented by insect species. Sheryl discussed damage caused by the larval stages of several moth species, an adelgid, and a scale insect.

Western spruce budworm *Choristoneura occidentalis* Freeman (WSBW) continued to be the most widely distributed defoliator in the West. Millions of acres of host stands have been affected. Populations were very active in MT, northern ID, OR, WA, British Columbia, and Alberta. Some locations in British Columbia are in a 20+ year outbreak and it appeared that WSBW has moved into higher elevations and more northern latitudes. In CO, WY, NM and AZ, WSBW populations have declined, but remain active. In AK, adult budworm moths (some may be eastern budworm *C. fumiferana* Clemens) were found in spruce forests between the Alaska and Brooks Ranges—the greatest number of moths were captured near the Yukon River.

Another defoliator, Douglas-fir tussock moth *Orgyia pseudotusgata* McDunnough was active in CO, OR, WA, and British Columbia. The outbreak in 2008 in Colorado was the largest in over a decade with 1,800 acres of Douglas-fir defoliated. Populations in NM and AZ collapsed to no visible defoliation in 2008 after approximately 3,000 acres had been detected in 2007.

Aspen decline and defoliation continued in many areas in CO, WY, SD, NM, AZ, ID, UT, and NV. Tent caterpillars *Malacosoma* spp, large aspen tortrix *C. conflicta* Walker, leaf rollers, and scale insects were responsible for much of the defoliation. In other areas aspen decline is occurring in the absence of noticeable defoliation. Studies attempting to determine the cause of decline continued in several western Regions.

Miscellaneous defoliators: Balsam woolly adelgid *Adelges piceae* Ratzburg has expanded its range in the last several years and continued to impact true firs, causing tree decline and mortality—especially in subalpine fir. A less-common looper called Mountain Girdle, *Enypia griseata* Grossbeck, was responsible for 2,300 acres of defoliation in AZ. In other areas this looper is described as innocuous, but tree mortality is occurring especially in spruce where heavily defoliated trees are then attacked and killed by spruce beetle *D. rufipennis* Kirby. In eastern MT, several thousand acres of ponderosa pine were once again defoliated by pine tussock moth *Dasychira grisefacta* Dyar. Gypsy moth *Lymantria dispar* L. introductions continued and two eradication projects were conducted in 2008, in Ojai, CA, and Harrison Hot Springs, British Columbia.

An interesting non-defoliator-related issue was western larch discoloration observed in many locations from Canada south to the Nez Perce NF in central ID. Trees had yellow to yellow-brown needles with necrotic tips. Discoloration held on until fall needle-shed. Most believe the damage was caused by late-spring frosts.

Invasive Insects/Early Detection and Rapid Response Program in the West.

Terry Rogers, USDA Forest Service, Forest Health Protection, Albuquerque, NM.

Early Detection and Rapid Response (EDRR) efforts in the West are part of a nationwide program being conducted by USDA Forest Service (USFS) and APHIS. In addition, USFS and APHIS are also addressing recent introductions of Asian longhorned beetle *Anoplophora glabripennis*, emerald ash borer *Agrilus planipennis* Fairmaire, and European woodwasp *Sirex noctilio* Fabricius—species most likely introduced in solid wood packing material (pallets).

These EDRR efforts are based on a pilot study developed by Robert Rabaglia, Donald Duerr, Robert Acciavatti, and Iral Ragenovich**,** titled "Early Detection and Rapid Response of Non-Native Bark and Ambrosia Beetles." This EDRR Program was established because of concern over invasive introductions from other parts of the world. As we have come to realize, international travel and import and export of commodities have greatly increased the potential for introduction of non-native species—of both plants and animals.

In spring 2000, National Plant Board and National Association of State Foresters requested APHIS and USFS coordinate their invasive species efforts to avoid redundancy. In April 2001, a memorandum of understanding (MOU) was formalized between USFS and APHIS. An Exotic Pest Rapid Detection Team was also established to develop strategies for an EDRR program.

Ten insect "species of concern" were targeted based upon frequency of past interceptions at ports of entry. They are:

Orthotomicus erosus	*Tomicus piniperda*
Pityogenes chalcographus	*Hylugops palliatus*
Ips sexdentatus	*Hyluogops ligniperda*
Ips typographus	*Trypodendron domesticum*
Tomicus minor	*Xyleborus* spp.

Target species were trapped using species-specific chemical lures in Lindgren traps: methyl butenol and cis verbenal; α pinene and ethanol; ethanol alone; and chalcogran (Chalcoprax®).

From 2001 to 2005, protocols were pilot tested and refined at more than 300 trap locations in 22 states. Chalcoprax®, used to attract *Pityogenes chalcographas,* was later dropped because of its expense and the time it took to get from its sole source in Germany.

In 2006, the program finally came together: 1) WO appointed a project coordinator; 2) USFS and APHIS further identified and coordinated their respective roles; 3) FHTET began development of a project database; and 4) the Project Team developed a strategic implementation plan.

In the first 5 years of the Pilot Project, five species of scolytids were identified as new to North America:

2001 – *Hylurgops palliatus* near Erie, Pennsylvania
2002 – *Xyleborus similis* in Houston, Texas
Xyleborus glabratus near Savannah, Georgia
2003 – *Scolytus schevyrewi* in Colorado and Utah
2005 – *Xyleborus seriatus* in Massachusetts

Some of these species, ones indicated by low trap catches, may be recent introductions. Those species indicated by higher trap catches may have already become established. An example of the latter is the banded elm bark beetle, *Scolytus schevyrewi* Semenov. While these exotic species may be present, to date no economic damages caused by them have been observed.

In 2009, the following states will be added to the EDRR trapping program: Arizona, Montana, Kansas, South Dakota, Wyoming, Nevada, and Hawaii.   In 2010, the EDRR program will be reevaluated.

	EDRR 2007 Species	Exotic/Native	CA	UT	WA	CO	OR	Sum
European shot hole borer	Anisandrus dispar	E	2	17	1	0	0	20
Tea shot-hole borer	Euwallacea fornicatus	E	1	0	0	0	0	1
European bark beetle	Hylastes opacus	E	0	6	2	0	0	8
	Hylastinus obscurus	E	0	5	0	0	0	5
bark beetle	Hypothenemus eruditus	E	1	0	0	0	0	1
bark beetle	Hypothenemus seriatus	E	1	0	0	0	0	1
	Orthotomicus erosus	E	6	0	0	0	0	6
European elm bark beetle	Scolytus multistriatus	E	13	10	0	0	69	92
Shothole borer	Scolytus rugulosus	E	1	35	0	0	3	39
Banded elm bark beetle	Scolytus schevyrewi	E	1	2,308	1	11,566	1,893	15,769
Fruit-tree pinhole borer	Xyleborinus saxesenii	E	512	1,037	162	36	484	2,231
ambrosia beetle	Xyleborus californicus	E	4	0	0	0	0	4
	Sum Exotics		538	3,418	166	11,602	2,449	18,173
	Sum Natives & Exotics		4,146	7,401	321	11,883	4,098	27,849

	EDRR 2008 Species	Exotic/Native	ID	NE	NM	AK	CA	Sum
European shot-hole borer	Anisandrus dispar	E	15	0	0	0	0	15
	Hylastinus obscurus	E	2	0	0	0	0	2
European elm bark beetle	Scolytus multistriatus	E	14	36	0	0	10	60
Shothole borer	Scolytus rugulosus:	E	88	1	0	0	6	95
Banded elm bark beetle	Scolytus schevyrewi	E	53	96	30	0	281	460
Asian ambrosia beetle	Xyleborinus alni	E	3	0	0	0	0	3
Fruit-tree pinhole borer	Xyleborinus saxesenii	E	169	307	15	0	844	1335
ambrosia beetle	Xyleborus californicus	E	0	2	0	0	4	6
Granulate ambrosia beetle	Xylosandrus crassiusculus	E	0	5	0	0	0	5
	Sum Exotics		344	447	45	0	1145	1981
	Sum Exotics & Natives		1135	4369	114	340	1425	7383

Above Tables: Results from EDRR trapping conducted in 2007 and 2008 in the western US.

HARD TIMES FOR HARDWOODS – NEW PROBLEMS FOR WALNUTS, OAKS AND ELMS IN THE WESTERN US

Moderator: Tom W. Coleman, USDA Forest Service, FHP R5

Highly valued hardwood species, representing significance to agriculture, biodiversity, wildlife, and aesthetics, are under pressure from emerging insect and pathogen problems in the western U.S. Forest entomology and pathology research is often directed to conifer species, but increasingly new concern for hardwoods has captured the attention of the public, researchers, and forest health specialists.

The objective of this symposium is to provide a unified platform where researchers working with hardwood species can interact and inform fellow researchers and land managers of new forest health issues to our valuable hardwood component. The issues spread throughout the western states and represent a range of interactions: 1) A fungus with an unknown origin that is associated with a native twig beetle species; 2) An introduced bark beetle impacting native hardwoods; and 3) A new wood borer introduction on native hardwoods.

Walnut in the West: Death by a Thousand Cankers

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In the past decade, extensive mortality of eastern black walnut, *Juglans nigra*, and dieback and mortality of northern California walnut, *J. hindsii*, and southern California walnut, *J. californica*, have been observed in the western United States. Damage is the result of attack by the walnut twig beetle *Pityophthorus juglandis* and subsequent canker development around beetle galleries caused by an unnamed species of *Geosmithia*, a fungus carried by the beetle. Although *Pityophthorus juglandis* and *Geosmithia* appear to be widespread on *J. nigra* in the western U.S., the distribution of this beetle and fungus on *Juglans* species native to the western U.S. has yet to be determined. We are currently determining the range and impact of *P. juglandis* and *Geosmithia* species in western stands of native *Juglans* species.

Host Colonization Behavior of the Walnut Twig Beetle, *Pityophthorus juglandis* Blackman, in California Hinds Walnut

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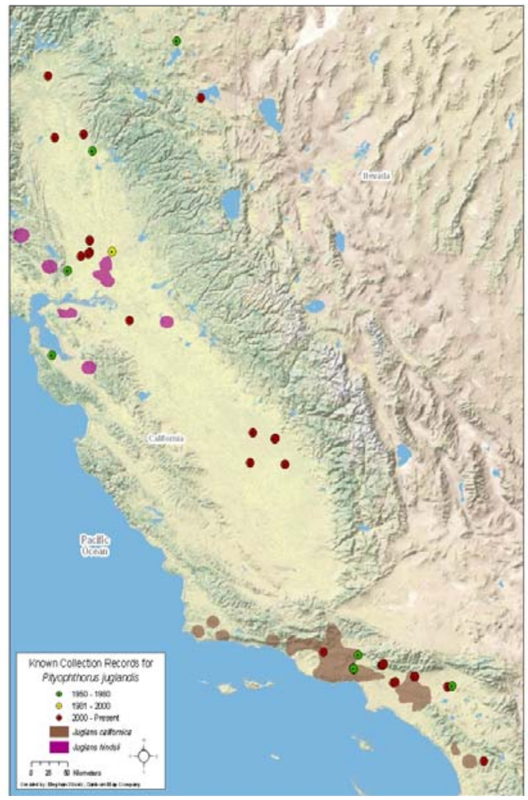
Thousand cankers disease, vectored by the walnut twig beetle *Pityophthorus juglandis* (Coleoptera: Scolytidae) was first recognized in 2008 in California. The fungus *Geosmithia* sp. and the beetle-fungus complex were widely collected and have caused tree mortality in urban and rural plantings of walnuts throughout the state. Infested and infected hosts included the two California native walnut species, *Juglans californica* and *J. hindsii*, and to a lesser extent *J. regia*, which is widely planted for commercial walnut production. The insect or the pathogen was also recorded from four other species of walnut at the USDA-ARS National Clonal Germplasm Repository near Winters, CA. *Pityophthorus juglandis* brood galleries on branches (1.5 cm and greater) are frequently associated with staining and initiation of *Geosmithia* canker formation. The beetles carry the fungal spores on their wing covers (elytra). Male beetles colonize cut branches in 4-9 days and are joined quickly by 1-2 females. Brood galleries are created, often near leaf scars and lenticels. Both sexes contribute to an aggregation pheromone that attracts beetles to infested branches. Other insects commonly emerging from dead walnut branches are the lead cable borer *Scobicia declivis* (a false powderpost beetle) and the oak cordwood borer *Xylotrechus nauticus* (a roundheaded wood borer).



Map: 1 Distribution of walnut twig beetle Pityophthorus juglandis *Blackman and native walnut* Juglans californica *and* J. hindsii *in California (S.J. Seybold and colleagues, unpublished data). Map created by M. Woods.*

Although some specialists suggest that *P. juglandis* is an invasive species in much of the western U.S., intensive collecting in 2008 in California and a review of California museum collections have revealed that the beetle is widely distributed in live, dying, and dead walnut branches in the state, ranging from San Diego Co. to Shasta Co. (Map 1). This twig beetle is likely a native associate of *J. californica* and *J. hindsii* in the state but was rarely collected or identified because forest entomologists have not tended to collect insects associated with native walnut, and because there were numerous cases of old, previously unidentified specimens in museum collections (e.g., 1959-Los Angeles Co., 1973-Riverside Co., 1974-Butte and Lassen Cos., 1977-San Mateo Co., 1980-Solano Co., and 1982-Sacramento Co.). The 1959 record from Los Angeles Co. and the 1974 record from a remote area of Lassen Co. suggest that the beetle was widely distributed in California long before thousand cankers disease was noted on walnut trees in the state. Thus, *P. juglandis* is likely a native beetle that was poorly collected in the past, but has increased in abundance since it has become associated with a potentially exotic fungal pathogen.

A Summary of Recent Research on the Banded Elm Bark Beetle in the Western U.S.

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The invasive European elm bark beetle *Scolytus multistriatus* Marsham was detected in Massachusetts a century ago, and now occurs throughout the continental U.S. and southern Canada. The Asian banded elm bark beetle *Scolytus schevyrewi* Semenov was discovered in the U.S. in 2003, and now occurs in 28 states and the province of Alberta, Canada. Although the indigenous populations of these two species are allopatric, the invasive populations are now sympatric in North America where they co-colonize elm trees *Ulmus* spp. A large-scale survey of these two *Scolytus* species was conducted with baited funnel traps, plexiglass panel traps, and *U. pumila* trap logs. Sites (four per locality) were monitored around Sacramento, California; Reno, Nevada; Ogden, Utah; Newcastle, Wyoming; and Fort Collins, Colorado (2006-2007), and Manhattan, Kansas and Columbia, Missouri (both only in 2007). Trap catches of *S. schevrewyi* relative to both *Scolytus* species captured from all three trapping methods at each survey site were 90% and 89% in Colorado, 90% and 83% in Wyoming, 60% and 68% in Utah, 43% and 68% in Nevada, and 11% and 13% in California (all in 2006 and 2007, respectively), and 3.3% in Kansas and 2.7% in Missouri (both only in 2007). General seasonal trends from all sites indicated peak flight in July and August for *S. schevyrewi* and two peaks (May-June and July-August) for *S. multistriatus*. Funnel traps baited with Multilure and 2-methyl-3-buten-2-ol were highly attractive to *S. multistriatus*, and mildly attractive to *S. schevyrewi,* whereas panel traps caught few beetles. *Ulmus pumila* trap logs were a more sensitive monitoring tool for detecting the presence of *S. schevyrewi*.

Elevated abundances of *S. schevyrewi* at survey sites in Colorado and Wyoming could be the result of competitive displacement of *S. multistriatus* by *S. schevyrewi*, which, if occurring, may be mediated in part by a differential response to elm hosts while adult beetles are in flight or by close-range behavioral interactions on or beneath the bark surface. Behavioral trials were conducted with baits consisting of small freshly cut logs (bolts) of American, Chinese and Siberian elm (*U. americana, U. parvifolia,* and *U. pumila*) with/without infestation by beetles. Trials were conducted in Cheyenne, Wyoming, and Fort Collins and Lakewood, Colorado to test the flight response of *S. schevyrewi*; around Sacramento, California to test the response of *S. multistriatus*; and in Reno, Nevada to test the responses of both species simultaneously. Studies with *S. schevyrewi* revealed that males and females aggregated towards host volatiles, but provided no evidence of response to a putative pheromone during the 0-48 or 48-96 hr period of infestation. In a cross-attraction study, *S. schevyrewi* displayed neither flight preference nor interruption to *U. pumila* infested with conspecifics, heterospecifics, or a mix of both species. Although *S. multistriatus* aggregates moderately to host volatiles and strongly to female-derived pheromones emitted after a few days, *S. multistriatus* may have a relative disadvantage by colonizing elm hosts more slowly than *S. schevyrewi*, which aggregates very strongly to host volatiles.

Studies of behavior and development on or below the bark surface revealed that *S. schevyrewi* was a stronger interspecific competitor than *S. multistriatus*. Smaller *S. multistriatus* progeny, and four-fold more *S. schevyrewi* progeny were produced when both species developed on the same host. The competitive advantage of *S. schevyrewi* larvae established through this study, and the more rapid response of *S. schevyrewi* to elm hosts established through flight studies, may be the key mechanistic components that facilitate the displacement of *S. multistriatus* by *S. schevyrewi*.

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Southern California Oak Woodlands have a New Resident: The Goldspotted Oak Borer

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A new pest to oaks has been impacting southern oak woodlands in San Diego County in California over the past seven years. In 2008, the goldspotted oak borer (GSOB) *Agrilus coxalis* was linked to the continuing oak mortality. The GSOB injures and kills coast live oak *Quercus agrifolia*, California black oak *Q. kelloggii*, and canyon live oak *Q. chryselopsis*. Oak mortality from several years of repeated injury from larval feeding is estimated at 17,000 trees from aerial surveys and occurs on all land ownerships. The wood borer was first collected in 2004 in California, but has been collected as early as the 1880's in southeastern Arizona and southern Mexico and Guatemala. No tree injury or mortality has ever been reported from GSOB in these native regions. The pattern of tree mortality in San Diego County and the North and Central American collection history suggest that GSOB was introduced into California during the mid- to late 1990's, most likely on firewood from either Arizona or Mexico. Very little data on the host information, biology, and life cycle of GSOB were available prior to 2008.

The larvae feed primarily at the interface of the phloem and xylem. Larval galleries are meandering and dark-colored. Pupation occurs in the outer bark. Infested trees can be identified by woodpecker foraging on the outer bark, crown thinning and die back, D-shaped adult emergence holes, and dark-colored staining on the bark. Bark staining signifies extensive injury from larval feeding, which eventually girdles trees and leads to their death. Studies are underway in 2009 to assess the current distribution of GSOB in southern California, effective survey techniques, impact of GSOB on forest stand dynamics, adult emergence from firewood and management of firewood, and comparison of introduced populations in California and native populations in Arizona.

To determine the current distribution and full season flight period of GSOB, purple and lime green sticky panel flight-intercept prism traps were established across the four National Forests in southern California. The most effective survey height is being assessed for each trap color (0 m, 1.5 m, and 3 m). Flight activity began in mid-May in 2009, which precedes the placement of traps in 2008 when we established that flight occurred from mid-June until early November in 2008. Peak activity in 2008 occurred in mid-June. The GSOB is believed to be univoltine in California.

To characterize the dynamics of the infestation, long-term plots were established in areas with and without current tree mortality from GSOB. Forest stand data, including tree species, infestation level, tree health, and tree mortality, were taken from 0.04 ha (tenth acre) plots. Infestation levels are reaching 88% in areas with evidence of long-term tree mortality from GSOB. The proportion of infested trees is lower in plots located at increasing radial distances from the communities of Descanso and Pine Valley near the Cleveland National Forest where initial mortality was mapped and the infestation is believed to have originated.

Mature larvae and pupae have been recovered from cut oak firewood. Firewood movement is potentially a means for spreading this new problem to additional areas of California. We are assessing adult emergence from cut wood and two methods for reducing GSOB populations in cut wood: 1) direct solarization; and 2) tarping wood with clear plastic sheeting.

Flight trapping is also being conducted with the endemic population of GSOB in southeastern Arizona to compare the adult flight period and trap catch densities to areas with widespread oak mortality in California. Four oak species are prominent in lower elevation oak woodlands in southeastern Arizona. Arizona white oak *Q. arizonica*, Gray oak *Q. grisea*, silverleaf oak *Q. hypoleucoides*, and Emory oak *Q. emoryi*, are common species found in canyons on the Coronado National Forest where previous collections of GSOB have occurred. Similar GSOB injury symptoms were noted on silverleaf oak and Emory oak. *Agrilus* sp. larvae were collected from the outer bark of a dead Emory oak. We suspect that these two native Arizona *Quercus* spp. are hosts of GSOB.

The non-native invasive GSOB has the potential to impact additional areas in California because the native distribution of confirmed hosts extends to more northern areas. Lack of natural enemies and/or lack of host resistance to GSOB herbivory are believed to be driving the increased oak mortality occurring in California. Additional studies are planned to 1) assess commercially available volatiles (Phoebe oil, Manuca oil, and *Z*-3-hexenol) for enhancing trap catch; 2) compare genetic variability between populations in California, Arizona, and Mexico; and 3) establish the relationship between tree water stress and successful attack.

CONCURRENT WORKSHOPS II:

CURRENT AERIAL SURVEY TECHNIQUES AND DATA USES
Moderator: Keith Sprengel

Using Aerial Survey Data to Enhance a Stand-specific Forest Health Hazard Rating System for Eastern Washington Landscapes

Scott McLeod, Washington State Department of Natural Resources

In 2007, DNR initiated a legislative mandate to address forest health issues in eastern Washington forests. The legislation authorized a new funding mechanism that allowed the department to treat stands with forest health issues that would otherwise be impossible to treat due to financial constraints. To help field foresters identify ‘at-risk’ stands, we used our stand-level inventory to develop a hazard rating system that provided indicators of over-stocking, insects, disease, fire, stand structure and successional status. Over-stocking was addressed through plant association, or habitat type following analysis that indicated individual plant associations exerted strong control over maximum stand density index. The insects evaluated included defoliators and bark beetles whose ratings were based on published sources. The beetle ratings also incorporated a proximity indicator derived in part from aerial survey data. A validation analysis of the defoliator ratings showed strong concurrence with aerial survey detections and severity. Inventory based disease indicators have proved elusive. Fire, structure and successional factors or conditions were generated using the Forest Vegetation Simulator (FVS) and DNR determined parameters. Aerial survey data were spatially overlain on the department's stand-level inventory to provide foresters with an indication of where problems currently existed. Hazard rating results suggest that excessive stand density is the most widespread problem facing eastside forests while defoliators have the greatest potential to be problematic among direct causal agents. The rating system is designed to provide a priority list for foresters to conduct field visits and then determine treatment priorities. The hazard rating system provides a baseline from which to track future changes across the landscape as well as to provide foresters a method to winnow down the over 7,000 stands comprising the forest lands managed by DNR.

Aerial Survey Data as a Forest Health Indicator in the Montreal Process

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One objective of the aerial forest health survey is to develop a historical record of insect and disease outbreaks. This record is helpful in understanding the ecological role of insects and pathogens in the dynamics of forest ecosystems and is an aid in predicting future outbreaks. These data can also serve as an indicator of the sustainability of our forests.

Sustainable development was a key agenda item at the 1992 United Nations Conference on Environment and Development (UNCED), the "Earth Summit," held in Rio de Janiero, Brazil. This Conference resulted in considerable dialogue on sustainable development and the criteria and indicators of sustainable forestry. In 1993, a UN seminar on sustainable development of temperate and boreal forests was held in Montreal, Canada. It was attended by 12 countries: Argentina, Australia, Canada, Chile, China, Japan, Korea, Mexico, New Zealand, Russia, USA and Uruguay. These countries encompass 60% of the world's forests and 90% of the world's temperate and boreal forests. This seminar, which became known as the "Montreal Process" identified 7 criteria and 67 indicators of sustainable forestry for temperate and boreal forests.

The Montreal Process includes one criterion: "Maintenance of forest ecosystem health and stability" and three indicators of forest health. Indicator 15, one of the three forest health indicators is:

> "Area and percent of forest affected by processes or agents beyond the range of historic variation e.g. by insects, disease, competition from exotic species, fire, storm, land clearance, permanent flooding, salinization, and domestic animals."

In 2001, I was contracted by the USDA Forest Service Forest Health Technology Enterprise Team to conduct an analysis of Indicator 15 for the period: 1996-2000. I used aerial survey data for a portion of this analysis.

The approach taken was to compile a historic record of acres of mortality or defoliation by year for the following insects: southern pine beetle, mountain pine beetle, Douglas-fir beetle, spruce beetle in Alaska, spruce budworm, western spruce budworm and Douglas-fir tussock moth. These data were taken from the national Forest Insect and Disease Conditions reports from 1979 to 2000. The "historic high" for each insect was identified and compared to the affected area for each year of the 5 year analysis period – 1996-2000.

Results of the analysis showed each the seven insects addressed in this analysis reached record highs between 1973 and 1997 and two; spruce beetle and spruce budworm in Alaska, reached historic highs during the analysis period.

Southern pine beetle – 1986 and 1995
Mountain pine beetle– 1981
Spruce beetle (Alaska) – 1996
Spruce budworm - 1978
Spruce budworm (Alaska) - 1997
Western spruce budworm - 1986
Douglas-fir tussock moth - 1973

A similar analysis is underway however, Indicator 15 has been somewhat redefined.

Validation of lodgepole pine susceptibility predictions for mountain pine beetle using aerial survey data

Helen Maffei and Michael L. Simpson, USDA Forest Service, Bend, OR
(presented by Andris Eglitis)

The Aerial Detection Survey of Insect Damage, a cooperative effort between the USDA Forest Service and the States of Oregon and Washington, provides valuable information for certain types of landscape analyses. The entire forested area of the Pacific Northwest Region is covered annually by the Survey, and all current mortality is mapped in a digital format.

This presentation focuses on the use of aerial survey information to test our standards for determining the susceptibility of lodgepole pine stands to infestation by the mountain pine beetle.

The components of this analysis include:
1) A lodgepole pine stand susceptibility model for mountain pine beetle
2) Aerial detection survey information aggregated for several years through then Mortality Mapper to identify overall tree loss per acre within the affected areas
3) Expanded base vegetation layer developed through the Gradient Nearest Neighbor Process (developed through Landsat TM satellite imagery and imputation of mapped pixels from a grid of 8378 CVS/FIA vegetation plots)

Using the statewide vegetation layer derived through the Gradient Nearest Neighbor process with plot data from 1996, all of the stands containing lodgepole pine in Oregon were identified. Our susceptibility model suggests that lodgepole pine stands are infested by the mountain pine beetle once they contain about 100 trees per acre that are greater than 9” dbh. Accordingly, the stand data were displayed to show the statewide gradation in number of trees per acre that were greater than 9” dbh as of 1996. In this way, stands expected to be susceptible could be identified on the landscape and compared with a retrospective summary of bark beetle activity that has occurred in recent years. The “Mortality Mapper” was applied to aerial survey data for the period between 1998 and 2007 to produce a cumulative tree loss layer that was overlaid onto the mapped susceptible stands. **The occurrence and intensity of mountain pine beetle activity over the past ten years corresponds very well with the areas predicted to contain susceptible stands.**

The fine-scale resolution of the base vegetation map (25 x 25m pixels) together with a quality aerial survey layer enable this type of analysis to be carried out.

INVASIVES ON OUR DOORSTEP

Moderator: Steve Munson, Group Leader/Entomologist, USDA Forest Service, R4- Forest Health Protection

The “Invasives on our Doorstep” workshop provided information on the Exotic Forest Pest (ExFor) website and risk mapping for several introduced forest insects and a pathogen. Other presentations focused on recent introductions of forest pests, summarizing current research initiatives and suppression/ eradication programs for the Mediterranean pine engraver, emerald ash borer and Asian long-horned beetle. Impacts of emerald ash borer were discussed in this workshop.

The Exotic Forest Pest (ExFor) Website and Risk Mapping to Identify Invasive Species on Our Doorstep

Marla Downing, USDA Forest Service, WO Forest Health Technology Enterprise Team, Ft. Collins, CO

The Exotic Forest (ExFor) Pest Website as well as susceptibility maps for *Orthotomicus erosus*, *Ips typographus*, *Sirex noctilio*, and also the pathogen *Phytophthora* were discussed in the presentation. New functionality for ExFor has been developed and is currently being moved into the Forest Service Data Centers for public dissemination. Once available, GIS distribution mapping will be available for about 150 invasive forest species of concern in North America. The ExFor invasive species records serve as a critical source of information for the Forest Health Technology Enterprise Team (FHTET) invasive species susceptibility mapping activities.

A Stranger in a Strange Land: Dispersal Behavior of the Mediterranean Pine Engraver in California's Central Valley

Steven J. Seybold, USDA Forest Service, Pacific Southwest Research Station; Deguang Liu, University of California – Davis; Robert C. Venette, USDA Forest Service, Northern Research Station; A. Steve Munson, USDA Forest Service, Forest Health Protection, R4; Beverly Bulaon, USDA Forest Service, Forest Health Protection, R5; Mary L. Flint, University of California, Agriculture & Natural Resources

Mediterranean pine engraver *Orthotomicus erosus* Wollaston is a nonnative species that was first detected in North America in 2004. The invasive population is located in the southern Central Valley of California. The dispersal characteristics of this insect are not known, but they are needed to accurately predict how quickly populations might spread. To estimate the intrinsic dispersal capacity of *O. erosus*, mark-recapture trials were conducted in the dry lakebed of the former Tulare Lake near Kettleman City, California (Kings Co.), a homogenous agricultural landscape with no hosts and very few trees or shrubs.

There was no evidence of a wild population of *O. erosus* at this site. Recapture rates were approximately 10%. Most recaptured beetles were trapped at distances 100 and 500 m downwind from the release point, and these moved to these locations within 20 to 60 minutes of release. A few individuals were recaptured between 4 and 10 km from the release point. Based on data collected during a similar study at another agricultural location in 2007, a distance-decay model predicted that approx. 40% of recaptured beetles would move less than 500 m.

The Emerald Ash Borer Invasion of North America: How can a Secondary Pest Threaten the Existence of an Entire Tree Genus?

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Emerald ash borer (EAB) *Agrilus planipennis* has killed millions of ash *Fraxinus* spp. trees in the lower Great Lakes region since its accidental importation from Asia. Congeneric relatives endemic to North America only colonize stressed trees, apparently as does EAB in Asia. However, EAB is killing healthy trees on high quality sites in North America, creating a wood-borer outbreak of unprecedented intensity.

We have established 38 transects containing 114 plots (0.1 ha) in forests of the Huron River watershed in southeast Michigan to quantify patterns and rates of ash mortality in relation to community composition, successional responses to gap formation including establishment and spread of invasive plants, as well as ash seed bank and seedling regeneration. We have also established a common garden study at the Michigan State University Tollgate Education Center in Novi, Michigan to document interspecific variation in ash resistance to EAB.

Once trees began to die in infested stands, ash mortality increased 30% per year, and is now at or near 100% for all species and size classes. There was no relationship between ash mortality and ash density, ash basal area, total stand density, or any measure of biodiversity. Impacts of ash mortality and associated gap formation on establishment and spread of invasive plants, native ground beetle assemblages, and course woody debris are also being quantified in these stands.

Ash species are the most common tree seedling in these stands, which could facilitate ash regeneration or provide continued host material that prolongs the EAB outbreak. Four years of sampling has revealed no ash seed bank.

After the 2008 growing season tree mortality averaged 99.2% across all plots with the majority of the few surviving trees clustered in the 1-2 inch diameter breast height (dbh) size class. Rate of black ash *F. nigra* decline and mortality was advanced about one year relative to that of white *F. americana* and green ash *F. pennsylvanica*. There was no relationship between ash mortality and ash density, ash basal area, ash importance, total stand density, total stand basal area, or any measure of biodiversity. From 2004 to 2006, percent ash tree mortality declined 2% with each km from the putative epicenter in Canton Township. However, this relationship was no longer significant in 2007, when as ash mortality exceeded 90% in all stands.

Besides ash, red maple *Acer rubrum* and elm *Ulmus* spp. are the most common species in the understory and seedling strata, and appear poised to exploit gaps created by ash mortality. Ash species are the most common species in the seedling layer, which could facilitate ash regeneration, or provide continued host material that prolongs the EAB outbreak. Four years of intensive sampling has revealed no ash seed bank. Invasive woody plant species are present in low numbers in almost all plots, and also appear poised to exploit gaps formed by ash mortality.

In the common garden study, Manchurian ash, which is native to Asia, was found to be much more resistant to EAB than North American green and white ash, perhaps by virtue of targeted defenses selected via its coevolutionary history with EAB. Phytochemical analysis of phloem revealed the presence of phenolic compounds unique to Manchurian ash that may represent a mechanism of resistance to EAB. Work is underway to more fully characterize resistance mechanisms, and to identify underlying genes and/or genetic markers that would facilitate a resistance breeding program.

Complete ash morality regardless of density and community composition suggests little potential for silvicultural management of EAB. The lack of an ash seed bank ash coupled with mortality of ash saplings before reproductive maturity suggests that long-term perpetuation of ash is precarious. However, the common garden study has revealed that Manchurian ash is a source of resistance genes, and a breeding program has been initiated by Dr. Jennifer Koch (USDA Forest Service, Northern Research Station, Delaware, OH) with the objective of hybridizing Asian and North American ash species.

The Asian Longhorned Beetle in North America: Round 5

David Lance, USDA APHIS PPQ, CPHST Otis Laboratory, Buzzards Bay, MA

The Asian longhorned beetle (ALB) *Anoplophora glabripennis* Motschulsky is a cerambycid pest of maples, birches, willows, elms, horsechestnuts, and a number of other tree species. The insect is native to Asia but has been inadvertently transported to North America in wood packaging materials on a number of occasions. At least five separate infestations have apparently started as a result (date discovered in parentheses): Brooklyn, NY (1996), Chicago, IL (1998), Toronto, ON (2003), eastern New Jersey (2004), and Worcester, MA (2008).

In these areas, the insect has attacked and killed apparently healthy trees in the groups listed above. Of these infestations, the recently discovered Worcester infestation is the most concerning as it is the largest of the group and is in close proximity to continuous woodlands that lead into our northern maple forests.

A. glabripennis is univoltine through most of its range. In the summer, female beetles lay eggs singly under the bark through pits they chew on boles and limbs of trees. Eggs hatch within a couple of weeks; larvae tunnel through and feed on phloem, eventually moving into the sapwood and heartwood in later stadia. They typically overwinter as larvae, resuming feeding, pupating and then emerging from round ~1-cm-diameter holes the following summer. Adults feed on foliage and the bark of twigs. The mating system involves contact and perhaps short-range attractant pheromones, but the apparent lack of long-range sex attractant or aggregation pheromones has frustrated attempts to develop an attractant-based monitoring system for the insect. As a result, survey is still accomplished by visually searching for beetles or the damage they do (oviposition pits, exit holes, frass, or adult feeding damage).

All known infestations in North America are under eradication by national (USDA APHIS PPQ or CFIA) and cooperating state and local agencies. In the U.S., USDA Forest Service, USDA-ARS, universities, and private organizations also contribute through outreach, restoration, and research. Eradication programs include several components. Regulatory measures are put into place to stop movement of infested wood into uninfested areas. Outreach efforts familiarize the public with the insect, our program activities, and the need for those activities.

To detect ALB, workers search host trees, often climbing trees or using bucket trucks to improve efficiency. Within areas that are found to harbor an active infestation, all trees of known host species are treated to control the beetle. Trees that are known to be infested are removed and chipped. Host trees that are not known to be infested may also be removed and chipped, or they may be thoroughly monitored and repeatedly treated with systemic insecticides, either by trunk injection or soil injection. Treatment of apparently uninfested trees is done, in part, because visual surveys are known to be less than 100% effective.

Design of survey and treatment schemes is based on scientific knowledge of the insect's biology and dispersal capabilities. When these actions have been carried out systematically and sufficient funding has been maintained, beetle populations have been severely suppressed and eventually eliminated locally. In Illinois, for example, no beetles have been found within the program area since 2003, and the infestation was declared eradicated in 2008.

MOUNTAIN PINE BEETLE AND HIGH-ELEVATION PINE MANAGEMENT

Moderator: Carl L. Jorgensen, USDA Forest Service, Region 4, Forest Health Protection, Boise, ID

In 2008, Aerial Detection Surveys recorded that approximately 120,000 acres of whitebark pine were affected by mountain pine beetle (MPB) in the Sawtooth-Salmon River region of Idaho. This figure does not include the several Wilderness areas of the region where there are many whitebark pine (WBP) acres that are not surveyed. Land managers have begun some projects to protect seed-producing trees from MPB and have enhanced areas for whitebark pine regeneration. Unfortunately, the projects are usually between 50-500 acres in size and only in a few easily accessible areas. Other areas of the West are experiencing similar situations for their high-elevation pine management. This workshop was an opportunity to share those situations by discussing the National Whitebark Pine Program; results from projects using verbenone to protect whitebark and limber pines from MPB; prescribed fire use for whitebark pine restoration; and an update on white pine blister rust resistance-testing for limber and bristlecone pines.

National Whitebark Pine Program Update

John Schwandt, USDA Forest Service, Region 1, Forest Health Protection, Coeur d'Alene, ID

What factors contribute to decline of WBP throughout it range—and how much does each factor contribute to the overall situation? Factors include: long time fire exclusion, white pine blister rust, MPB, and climate change. In addition to a general discussion of the national program and some of its accomplishments, John discussed the politics of having WBP listed on the "Threatened and Endangered Species" list, which could take another 6-8 years. If it happens, no one knows for sure if the positives will outweigh the negatives for restoration management.

Monitoring Verbenone Operational Use in Whitebark Pine

Dana Perkins, Ecologist, Bureau of Land Management, Challis Field Office, Challis, ID

This report documents four years of monitoring the use of verbenone to protect individual cone-bearing whitebark pines from mountain pine beetle attack on Poverty Flat near Clayton, ID. Protocols established by Kegley et al. (2003) were used to monitor over the course of the current ca. 2000 mountain pine beetle outbreak: 1) if verbenone treatments at high and low doses would protect individual trees better than no verbenone treatment; and, 2) if verbenone treatment effectiveness changes as the outbreak progresses over several years. This project differed from Kegley et al. (2003) and other similar studies because beetles were not drawn in by baits. This project relied on the naturally high, outbreak level of beetle pressure. The three treatments were: **Control** = no protection with verbenone pouches; **Low =** two pouches (5g verbenone/pouch) all season; and, **High** = four pouches (5 g verbenone/pouch) replaced mid-season **OR** as in 2007 and 2008, two pouches (7.5 g verbenone/pouch) all season. In 2007, the industry standard for verbenone pouches changed to 7.5 grams resulting a change in procedure. However, the "low dose" remained two 5g pouches in 2007. In 2008, the "low" dose treatment was eliminated from the monitoring. Pouches were stapled to the northwest and northeast sides of the bole. Results are consistent with Kegley et al. (2003) with the high dose treatment having higher survivorship than the low doses and higher than the control treatment (Fig. 1).

The efficacy of verbenone to protect whitebark pines is better during the initial stages of the outbreak as compared to later years (Fig. 1).

The question remains: Will the control and high dose treatment converge to equal amounts of survivorship after the outbreak runs its course? As of 2008, the high dose verbenone treatment had higher percentage of survivorship than the control. Another question discussed during the session was: Should more verbenone be applied to adjacent stems in tree clumps to protect the entire clump? The general consensus was yes.

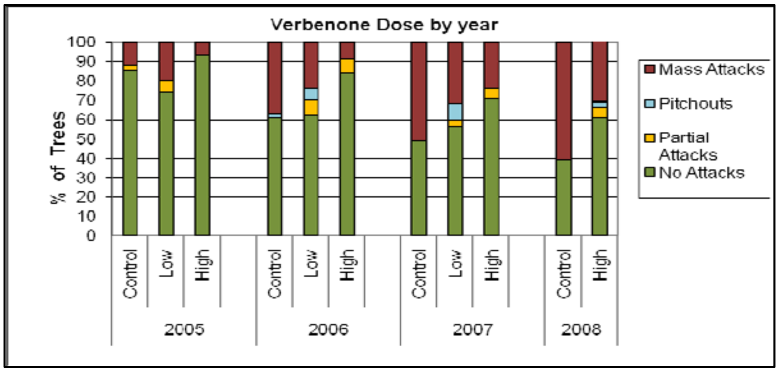

Figure 1. Efficacy of annual verbenone treatments to protect whitebark pine against mountain pine beetle attack from 2005-2008.

Kegley, S.J, K.E. Gibson, J. Schwandt and M. Marsden. 2003. A test of verbenone to protect individual whitebark pines form mountain pine beetle attack. FHP Rpt. 03-9, USDA Forest Service, Forest Health Protection, Northern Region, 6 p.

Prescribed Burning for Whitebark Pine Restoration-issues: Challenges and Concerns

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Whitebark pine *Pinus albicaulis* a keystone species in upper subalpine forests of the northern Rocky Mountains and Cascades in the United States and Canada, is declining in parts of its range because of recent mountain pine beetle *Dendroctonus ponderosae* and blister rust *Cronartium ribicola* epidemics, as well as advancing forest succession from fire exclusion. Many government agencies are initiating extensive efforts aimed at restoring these diverse and important forests. However, an extensive restoration study began in 1993 has yielded results that are important in the design and implementation of restoration activities for whitebark pine. Presented were situations that can occur in whitebark pine stands proposed for restoration treatments that are important for determining the success and efficacy of restorative prescribed burning treatments - prescriptions varying from stand-replacement burns, to mixed-severity fires, and non-lethal ground fires. Among the situations include current site conditions, whitebark pine mortality, observed weather, fuelbed, rust resistance, and a host of other important factors. Preliminary results indicate these restoration treatments are successfully restoring the fire processes at a small scale, but many challenges need to be met to achieve landscape scale whitebark pine ecosystem restoration. Seed collection in stands with high mortality from blister rust yielded planting materials with enhanced rust-resistance. Planting nursery- grown whitebark pine seedlings with some rust resistance has also had mixed success related to the time of year planting was done and the amount of precipitation after planting. Also discussed was the need to protect cone-bearing trees from mountain pine beetle. An important phase in restoration is prioritizing stands and landscapes in need of restoration and restoration strategies will most likely vary from site to site. One thing is certain, continuation of current management of this species will ultimately result in local to regional extinctions of this important species. A management guide with this information is expected to be out during the summer/fall of 2008 as a General Technical Report from the Rocky Mountain Research Station.

White Pine Blister Rust Resistance Testing and Protection of Limber and Bristlecone Pines in the Central Rockies

Sheryl Costello, USDA Forest Service, Region 2, FHP, Lakewood, CO; Anna Schoettle, USDA Forest Service, RMRS, Fort Collins, CO; Kelly Burns, USDA Forest Service, Region 2, FHP, Lakewood, CO

A severe mountain pine beetle outbreak in northern Colorado is impacting high elevation tree species and adding a new urgency to develop proactive restoration strategies for white pine blister rust (WPBR) in limber pine and RM bristlecone pine ecosystems. Mountain pine beetles are killing trees on sites with

>1000 yr old trees and sites with trees with confirmed genetic resistance to WPBR. Work has begun to prepare the landscape before rust invasion to mitigate ecosystem impacts. *In situ* protection of seed trees is being done by preventative spraying or the use of verbenone pouches. Seeds and pollen collections are being made to capture genetic diversity for conservation, restoration, and research. Collected seeds are currently being screened for partial and complete resistance to WPBR. Preliminary results of short-duration test screening of limber pine families for complete resistance reaction to WPBR indicated a 12% overall resistance for seedlings, ranging 0% to 29% per site. Long-duration test screening of limber pine families for partial (incomplete) resistance reactions to WPBR has begun and seedlings will be followed over the next several years. The short-duration complete resistance test for bristlecone with Pacific South West Research Station suggested a frequency of resistance of ~ 22% though no hypersensitive response was observed. Long-duration test screening in bristlecone pine for incomplete resistance reactions to WPBR found that in 2007, 47% of seedlings were showing symptoms of the disease, in 2008, approximately 60% of the seedlings were showing symptoms, and the seedlings will be monitored for symptoms and mortality from 2009-2011. Symptom development in bristlecone pine is slow making it too early to detect segregation within families. This work will hopefully enable direct genetic intervention by supplementing the population with individuals with heritable rust resistance traits before or early in invasion process. Additionally, stimulating natural regeneration in those populations will further prepare the landscape before invasion by maximizing genetic combinations to facilitate selection for resistance upon invasion.

On a related note, a verbenone study was conducted in northern Colorado during the summer of 2008 to test individual tree protection from mountain pine beetles in limber pine. Mountain pine beetle attractant pheromones were attached to 100 controls and 94 verbenone treated trees. Two 7.5 gram verbenone pouches were placed on the north side of the 94 verbenone treated trees. Due to the patchy distribution of the limber pine in this area, five distinct locations were utilized for the study. During the statistical analysis it was determined that sites 1 and 5 could be grouped together and sites 2, 3 and 4 grouped together, but not all sites could be analyzed together. Results from sites 1 and 5 indicated that 82% of the controls were attacked compared to 34% of the verbenone treated trees. Results from sites 2, 3, and 4 were less encouraging with 97% of the controls attacked and 73% of the verbenone treated trees attacked. It appears that verbenone is reducing attacks, but the level of efficacy depends on the site.

SCALES, ADELGIDS, AND OTHER MERISTEMATIC INSECTS

Moderator: Bobbe Fitzgibbon, USDA FS Region 3, FHP

This semiformal workshop had the purpose of discussing the current status, research, and discussions of multiple meristematic sucking insects.

Don Alstad, University of Minnesota, discussed the work he and George Edmunds completed on the black pineleaf scale *Nuculaspis californica* Coleman. The outbreak began in the Spokane area in 1946-47 and continued until the 1980s. George Edmunds was hired by Kaiser Steel to study the cause of the defoliation of ponderosa pine near its Spokane plant. The local citizens feared that the defoliation was caused by fluoride emissions from the Spokane plant. Edmunds determined that the defoliation was due to a scale. He also determined the details of the life cycle and causality of the outbreak.

There is one generation per year. In early July after the pine needles are fully extended, the females lay up to 70 eggs protected under the maternal hard scale covering. Eggs hatch quickly and the larvae harden before walking to feeding positions. Since the larvae are vulnerable to desiccation, most do not leave the twig their mother occupies. However these “crawlers” are susceptible to wind dispersal and can be blown to uninfested trees to found new colonies. The larvae then insert their mouthparts through a stomate, release proteolytic enzymes that cause lesions and feed on the mesophyll tissues of the needle. They then secrete a waxy protective scale cover, firmly attaching it to the needle. Once attached, the larvae molt into a legless second instar and females never move from this position. The larvae feed throughout the fall and go into a diapause for the winter, molting into a third instar in early spring. Winged males reach adulthood in mid-May, emerge from their scale cover and mate with females on the same or adjacent needles. Dispersal is attributed to the "crawler" stage and the winged males by passive transport, becoming part of the aerial plankton.

The black pineleaf scale has a complement of natural enemies. Damaging outbreaks only occur where these biological control agents are compromised or absent. *Coccinelid* predation affects the dynamics of *Nuculaspis* as a general predator. The major impact to populations is an *aphelinid* parasitoid *Coccobius varicornis* Howard. Outbreaks occur when the effectiveness of the natural enemies are compromised by dust from unpaved roads (which was the case at the Kaiser plant) and where they are absent due to insecticide drift from orchards. Both reduce the wasp's effectiveness, thereby allowing variations in scale density.

Edmunds and Alstad began transfer experiments moving the scales from infested trees to uninfested trees and from infested trees to other infested trees and within the same infested tree. They then quantified the insect survival. These experiments were conducted in several different field sites. Infested pines were chosen with a wide variation of physical condition judged by needle elongation and retention in order to detect local adaptation associated with host vigor. They found that scales from one tree often did not survive on a new tree, an indication of possible adaptation to a single tree.

Further population dynamics work found that hatching and mating sex ratios varied from tree to tree. The population was found to be slightly female biased implying that the population is not panmictic. Most of the tree to tree sex ratio variation was observed late in the insects' life cycle and was attributed to extensive male mortality after settlement and before mating. Males of this family of scale insects are hemizygous; the alleles are expressed differentially in males than in females with a survival advantage to females. Greater female bias was found where trees contacted each other than on isolated sides of the trees. Alstad implied a definite population genetic structure which points to adaptation to single trees. This effect is due to phenotypic and environmental expressions and is independent of tree genotype.

Ingrid Aguayo, pest specialist for the state of Colorado, discussed the aspen scale issue occurring in Aspen, Vail and Carbondale, Colorado and Ketchum, Idaho. Dr. Aguayo presented a power point generated by Bob Hammon, a Colorado State University Extension Agent. The aspen scale was identified as *Diaspidotus gigas* (*Diaspididae*) by Kozar, Hodges and Miller. It is a non-native pest; studies have been conducted in Checkloslovokia and it is listed in the Scale Insects of Central Europe by Kosztarab and Kozar. In Colorado aspen scale is found mainly on urban trees, which implies that high stress makes the tree susceptible. The attack causes bark lesions. In Idaho however, it occurs on natural stands of aspen, causing bark pitting and death. In Europe the scale has one generation per year, but it is thought to have multiple generations in the US since crawlers have been found at various times of the year. Males have been seen in May and June. There may be predation by a Coccinellid and exit holes have been seen on some scales indicating a parasitoid. The Extension Agents are recommending Safari or a spring pre-leaf oil as forms of control.

Lee Pedersen reported on the status and monitoring of balsam woolly adelgid *Adelges piceae* Ratzeburg in the Northwestern US. The insect was introduced into the eastern North America in the early 1900's where it impacted balsam fir and Fraser fir. Balsam woolly adelgid (BWA) was moved into the western states where it was found in subalpine fir in the 1920's grand fir in the 1950's. It has also been found infesting Pacific silver fir. In 1983 it was found in the Idaho panhandle and may have moved into Montana as of 2007. There is a population on Vancouver Island in British Columbia; the export of logs from this island is prohibited.

The insect has 2 to 4 generations per year. Wingless females lay 200 eggs and cover them with cottony tufts. Crawlers are present in spring at bud break. This stage can be moved long distance by the wind or perhaps movement on birds or other animals. The crawlers disperse, find a feeding site and transform into a resting stage called neosistens. In the mountains only the neosistens stage can withstand overwintering temperatures. Two immature stages and the adult stage follow, these are called sistentes. Spring development begins in April or May and most of the insects have reached adulthood by late June.

The damage to the trees includes gouting (the stunting of the terminal growth with swelling of buds and nodes), irregular growth, and the formation of compressed wood in the main stem. Subalpine fir dies after 3 to 5 years and 15 years for grand fir. The insect prefers vigorously growing mature trees but all sizes are attacked. Initial damage and mortality is considerable in stand populations maintained at lower elevation sites. Long term effects of infestation includes deterioration of the ecosystem, species displacement and impacts to watersheds and wildlife. Forest composition changes; fir is replaced by spruce. Grand fir has not been as greatly impacted. Often grand fir is mixed with white fir which is resistant to BWA.

BWA infestations are spotty but widespread. Aerial detection of infestations is difficult. The signature of an old infestation is fading of foliage and branch flagging. New infestation appears as a black-colored crown due to lichen cover. Remote sensing data can distinguish BWA from western balsam bark beetle damage.

Biocontrol efforts include the identification of 23 parasitoids of which 6 have established in Oregon and Washington but these have had no known impact on the population so far. In addition to population and host mortality monitoring, research on remote sensing methodology and host switching behavior are planned.

PLENARY SESSION II: FIRE AND INSECT INTERACTIONS

Moderator: Robert Progar, Pacific Northwest Research Station, La Grande, Oregon

Influence of fire on western bark beetles

Joel McMillin

The question of how fire subsequently affects bark beetle behavior and populations was posed nearly a century ago (reviewed by Miller and Patterson 1927). Early investigations on this topic attempted to quantify 1) bark beetle activity in fire-damaged trees and their contribution to tree mortality following wildland fire and prescribed burns, 2) primary attraction cues for drawing bark beetles to fire-damaged trees, and 3) beetle reproductive potential in fire-damaged trees and likelihood of fire initiating bark beetle outbreaks. Increasing numbers of large fires in forests of western North America have generated a renewed interest in fire-bark beetle interactions. This presentation reviewed results from the latest studies addressing these three main subject areas.

Two models recently developed to predict tree mortality following wildland fires in ponderosa pine (Sieg et al. 2006) and Douglas-fir (Hood and Bentz 2007) forests were compared. Both models included a measure of crown damage (scorch or scorch plus consumption), tree diameter, and bark beetle attacks, but only the Douglas-fir model included cambium injury. An interesting pattern emerged for probability of Douglas-fir mortality relative to tree diameter. Due to insulating affects of thicker bark, large diameter Douglas-fir have lower probability of mortality caused by fire effects alone; however, because Douglas-fir beetle prefers to attack large diameter trees this results in increased likelihood of mortality when the presence of bark beetles are included in the model. In the ponderosa pine study that was conducted across four different western states, the percent of fire-damaged ponderosa pine trees with bark beetle attacks ranged from 6 – 26% for *Ips* species to 5 – 29% for *Dendroctonus* species. An external validation of the ponderosa pine model correctly classified mortality of 96% of 1,361 trees 3-years postfire.

Results from these wildland fires were contrasted to contemporary studies on bark beetle response to prescribed burns. Breece et al. (2008) reported that bark beetle attack levels increased by approximately 10% in ponderosa pine stands following prescribed burning compared with unburned stands. Logistic regression analysis determined that probability of tree mortality was related to total crown damage (scorch plus consumption) and bark beetle attack rating (no attack, partial attack, or mass attack). This work also illustrated the importance of sampling at multiple heights for bark beetle attacks rather than just at diameter at breast height; probability of *Ips* egg galleries increased 3.7 times for every 2 m increase in height.

The role that pine resins/host odors play in primary attraction of bark beetles to fire remains unclear, but seems to vary by host tree-bark beetle system. For tree-killing bark beetles infesting pine trees (e.g., western pine beetle, mountain pine beetle, *Ips*), attraction does not appear to be strongly influenced by changes in host compounds, while there is limited indication that certain host compounds may be involved with host selection by Douglas-fir beetle and spruce beetle. Evidence from work by Kelsey and Joseph (2003) suggests that elevated concentrations of ethanol in fire-damaged or fire-killed trees may act as a cue for attracting secondary bark beetles (e.g., red turpentine beetle) and wood borers.

Production of terpenes/resins and resin flow rates following fire are likely influenced by several factors and the complexities of these factors may result in differing results among studies. For example, tree health prior to fire, season of fire, post-fire weather conditions, tree size/age, in addition to the severity of fire damage to either the crown or bole, may all affect subsequent output of defensive compounds that determine the probability of bark beetles successfully colonizing their hosts. Recent research from northern Arizona suggests that ponderosa pine trees sustaining crown scorch greater that 75% have decreased induced resin defenses and therefore increased susceptibility to bark beetles (Wallin et al. 2003).

Brood production of bark beetles varies by intensity of fire-caused tree damage, host-bark beetle system, and tree size. For instance, Douglas-fir beetle has elevated brood production in large diameter trees at intermediate levels of fire damage compared with either low or very high levels of damage and small diameter trees (Cunningham et al. 2005). Conversely, beetles such as mountain pine beetle (Safranyik et al. 2001, Elkin and Reid 2004) and western pine beetle (Miller and Keen 1960) may have decreased or no change in brood production rates in moderate to high levels of fire damage compared with unburned trees. Species differences in brood production may translate into whether fire will result in a subsequent outbreak either within or outside the fire zone. Among the tree-killing bark beetles of western North America, Douglas-fir beetle seems to have the greatest tendency to reach outbreaks following fire, which may be caused in part by greater reproductive potential in trees sustaining moderate levels of fire damage. In addition, it is important to point out that suitable stand conditions (i.e., large diameter hosts occurring in dense stands) must be present for outbreaks to occur over an extended duration. Furthermore, weather conditions conducive to fire may also be favorable to beetle population increase (i.e., drought); therefore, deducing what factors are driving beetle population dynamics can be problematic.

In conclusion, recent research has confirmed the importance of including bark beetle attacks in models predicting tree mortality following wildland fires and prescribed burns. These models can assist managers in making post-fire management decisions related to hazard tree removal, reforestation, salvage logging, wildlife habitat, and watershed quality (Parker et al. 2006). In general, bark beetle contributions to tree mortality following prescribed burns are relatively low (<10 %) and are probably acceptable by land managers (Breece et al. 2008). An exception might be when prescribed burns lead to increased mortality of old-growth trees in restoration projects (*sensu* Perrakis and Agee 2007). Despite the long-standing recognition that answers to fundamental questions addressing fire-bark beetle interactions are critical for understanding forest ecology and managing forests, there are several aspects still requiring additional study. For example, additional investigations are needed to tease apart what primary attraction cues are important in host selection versus random selection of hosts and how host defenses vary with levels and timing of tree damage. Stevens and Hall stated in 1960 that “bark beetle outbreaks after fires follow no set pattern”; however, continued monitoring of bark beetle response to fires will help to strengthen our conclusions regarding patterns and processes.

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Effects of Forest Insects on Fire Risk and Behavior

Richy J. Harrod, Deputy Fire Staff Officer, U.S. Forest Service, Okanogan-Wenatchee National Forest, 215 Melody Lane, Wenatchee, WA 98801

The number of acres burned in wildfires across the West has been increasing since the late 1980s. Many of these fires have burned more severely than compared to the historical period when fires were more frequent on the landscape. The current increase in size and severity of wildfires can be attributed to a variety of factors including increased fuel loading, high density forests, longer and drier fire seasons, and widespread insect caused tree mortality. On the Okanogan-Wenatchee NF, nearly 500,000 acres in past 20 years has been identified as having significant insect damage or mortality. In some locations, like the upper Okanogan, bark beetle mortality in lodgepole pine and spruce has been continuous and extensive. In the first few years following a bark beetle infestation in these forest types, canopy fuels become desiccated (red needles) and the potential for crown fire increases. As dead trees begin to fall, canopy fuels become discontinuous but surface fuels increase greatly leading to the potential for high soil severity wildfire. The Tripod Fire in 2006 burned approximately 180,000 acres of bark beetle killed lodgepole pine and spruce; the fire perimeter closely matched the mapped extent of the beetle infestation.

Bark beetles are present in dry forest types, but their extent has not been as great as in the higher elevation forests. Fire hazard is currently high in dry forest types and the presence of bark beetles only changes hazard slightly, largely by locally increasing surface loading. Defoliating insects, such as western spruce budworm and Douglas-fir tussock moth, have caused widespread defoliation primarily in Douglas-fir from the Teanaway Watershed south to nearly Mount Adams. This insect activity has not lead to widespread mortality, therefore canopy or surface fuels are not rearranged. When dead needles fall canopy fuels decrease some (depending on severity of infestation) and recent research would suggest no change in fire behavior. Mitigation of fire hazard in dry forest types by thinning and prescribed burning can also decrease the potential for serious bark beetle outbreaks. Widespread insect mortality in high elevation forest types is best managed by allowing fire to create stand replacing patches so that landscapes consist of a multitude of different age classes.

Wildfire in the West: Past, Present, Future

Don McKenzie**,** Pacific Wildland Fire Sciences Lab**,** US Forest Service

Fire regimes have multiple attributes, including frequency and severity, seasonality, vegetation, and types of controls (climate, fuels, ignition sources). Fire frequency in particular is estimated differently in high-severity vs. low-severity fires, and is difficult to characterize for mixed-severity fire. Temporal and spatial properties of fire, such as frequency, duration, areal extent and spatial heterogeneity, interact to form spatial patterns on the landscape, and interact with vegetation succession to produce landscape memory of disturbance regimes. I hypothesized that disturbance will be the principal agent of ecosystem change in response to global warming, because disturbance resets succession and subjects organisms to a warming climate and increasing drought at the most sensitive stage of their life-cycle -- establishment.

Researchers use three types of techniques for understanding climate-fire interactions: past reconstructions from fire scars, stand-age distributions, and charcoal sediments; statistical analyses using instrumental records, and simulations of future conditions. Each is most effective at a particular spatial and temporal resolution and extent. For example, lake-sediment charcoal records date back up to 10,000 years, but have only a decadal temporal resolution.

Projections for future disturbance in the West suggest more area burned by fire, probably with higher severity and larger patch sizes, and increasingly unpredictable synergistic effects of multiple disturbances interacting with warming temperatures and future land use. I gave several examples of "stress complexes," combinations of changing disturbance regimes, global warming, and anthropogenic factors. The West will continue warming through the 21st century even if greenhouse gas emissions were stopped today. Fire regimes may change in unexpected ways. I proposed a generic management approach of anticipating future disturbance regimes and incorporating their effects into planning at broad scales, expecting in particular that landscape patterns from multiple disturbances will be generally coarser (larger patches) with individual patches perhaps being more homogeneous due to increased severity of disturbance.

CONCURRENT WORKSHOPS III

Non-traditional Pesticides and Biocontrol for Defoliators

Moderated by Cynthia Snyder, USDA Forest Service, Pacific Southwest Region

This workshop explored and discussed several ongoing projects involving the use of biological control or biopesticides. Classical biological control is the importation and/or augmentation of a natural enemy (ies) of a pest species (i.e., predators and parasites). Biopesticides are biologically derived pesticides such as *Bacillus thuringiensis* (Bt) or virus used to suppress a pest agent.

Birch Leafminers in Alaska

John Lundquist and Robert Progar

The ambermarked birch leafminer (ABLM) *Profenusa thomsoni* Konow (Hymenoptera: Tenthredinidae) first reported in Anchorage, Alaska in 1996, causes blotch mines often resulting in premature leaf drop. Damage is mainly aesthetic, but thousands of dollars have been spent by Anchorage homeowners on chemical control measures.

The pest was thought to have been introduced to Alaska from western Canada. It has been spreading since the initial report. Statewide surveys, initiated in 2002 detected the amber-marked birch leaf miner in Fairbanks, the Kenai Peninsula, Haines and Skagway.

In 2003, Chris MacQuarrie, a graduate study from the University of Alberta, and in 2006, Anna Soper, a graduate student from the University of Massachusetts-Amherst, made an effort to introduce a parasitic wasp as a biological control of the ambermarked birch leafminer. Originally misidentified as *Lathrolestes luteolator*, this parasitoid has recently been determined to be another as yet unidentified

Lathrolestes sp., not matching any previously described species in the genus.

According to a recent progress report, 3,636 individuals of this parasitoid were released in Anchorage from 2004-2008. In 2007 and 2008 parasitoids of this species were recovered at several Anchorage release sites, indicating that this species is now established and increasing in numbers. Research by Anna Soper found that the local leafminer population is also attacked by a presumably native parasitoid (*Lathrolestes sp.* "black face", which is also a new species under description), which may help with control of the pest. In addition, a facultative hyperparasitoid *Aptesis segnis* Provancher has been found to heavily attack the local native *Lathrolestes* sp. and its future impact on the introduced biocontrol species will be a subject of investigation. Population levels of the leafminer and its parasitoids will continue to be monitored.

A parallel project was conducted at the Alaska Botanical Garden in Anchorage in 2008, where sites were treated with an aqueous solution of either the parasitic nematode *Steinernema carpocapsae* or the entomopathogenic fungus *Beauvaria bassiana* for control of amber marked birch leaf miner. In 2008, there were significantly fewer ABLM emerging from the *Beauveria bassiana* treatment than from the untreated control and the nematode *Steinernema carpocapsae* treatments.

The birch edge leaf miner *Heterarthrus nemoratus* is becoming increasingly dominant relative to amber-marked birch leaf miner. Although this leaf miner causes less severe damage on individual leaves, its prevalence is increasing rapidly.

Douglas-fir Tussock Moth in British Columbia

Lorraine Maclauchlan

The Douglas-fir tussock moth (DFTM) is a native species in which the larval stage feeds on the needles of Douglas-fir and other trees. In high population cycles, DFTM can consume the needles to the point of tree mortality. Outbreaks occur every ten to twelve years, last for a period up to four years and can cause significant levels of damage and mortality to Douglas-fir in the interior of the province.

The proposed treatment for the tussock moth includes the aerial application of nuclear polyhedrosis virus, a naturally occurring virus specific to the tussock moth that causes extensive mortality to the insect but has no effect on other organisms. The virus has been isolated and is federally regulated and registered for managing the tussock moth.

In the fall of 2007 egg mass surveys for DFTM in various crown land forests near Kamloops suggested that an outbreak was expected for the spring of 2008. These areas received a spring 2009 aerial treatment of nuclear polyhedrosis virus. Life stage surveys will be conducted to determine efficacy of the treatment.

Gypsy Moth in California

Cynthia Snyder

Eleven gypsy moth adults were trapped in five counties in California in 2008. In Ojai, Ventura County, seven adults were trapped in 2007 and suspect egg masses were found on oak trees on two separate private properties. One of the properties had an airstream trailer from Grand Marais, Michigan, parked under the oak trees that contained the egg masses. Partial samples of egg masses were collected and shipped to the Plant Pest Diagnostics Lab.

Sterile egg masses were placed out to monitor for emergence and time treatment applications. Efforts coordinated primarily by CDFA and APHIS will be made in 2009 to eradicate the Ojai population by ground spraying Bt.

Light Brown Apple Moth in California

Cynthia Snyder

Light brown apple moth *Epiphyas postvittana* (Lepidoptera: Tortricidae) was reported in Berkeley, California in 2007 and is now in 12 counties. The greatest concentrations of moths have been caught in Santa Cruz and Monterey counties. Larval and pupal stages have been found in 46 nurseries, flower or greenery farms along the central coast area (7 counties). Quarantine procedures were put into effect over a 182 square mile area. Originally from Australia, it is known to be established in New Zealand, New Caledonia, Hawaii and the British Isles. Its discovery in California was new North American record.

The hosts of this pest include 200+ plants in 20 genera in 50 families including apple, pear, peach, apricot, cherry, almond, avocado, grapes, strawberries, corn, peppers, tomato, carrot, alfalfa, rose, oak, willow, poplar, cottonwood, coast redwood, pines and eucalyptus.

Nurseries with host plants confirmed as infested have option to destroy infested material or treat with chlorpyrifos. Three ground applications of *Bt* were applied in 2007 in Oakley and Napa. Hand applied pheromone applications (Isomate-LBAM, twist ties) occurred in Oakley, Napa, Danville, Dublin, San Jose, Sherman Oaks and Vallejo/Mare Island during 2007.

The population of the light brown apple moth continued to increase in 2008 throughout the coastal area of central California primarily from Monterey to Sonoma Counties with outlying populations in Napa and Santa Barbara Counties. Eradication efforts using aerial spraying of pheromones for mating disruption were halted due to public concerns and court orders. Ground treatments using twist ties impregnated with pheromones continued. The eradication program will be reinstituted using sterile moth releases in 2009.

The first detection of feeding injury was noted in 2008 in the areas with the highest populations of the moths, Soquel in Santa Cruz County and Golden Gate Park in San Francisco. Minor defoliation and leaf injury were noted on Australian Tea Tree in Golden Gate Park and on various hosts in the Soquel area.

The impact on production costs for LBAM hosts in CA could top $160-640 million. Some countries have specific regulations against this pest so additional measures may have to be taken (pre and/or post harvest treatments). Mexico and Canada have imposed sanctions against the spread of the moth. States in the U.S. may impose restrictions on the movement of potentially infested fruits, vegetables and nursery stock. Several states are requesting pre-shipment notification for farm products and nursery material.

Erythina Gall Wasp in Hawaii

Cynthia Snyder

Erythina gall wasp (EGW) *Quadrastichus erythrinae* Kim (Hymenoptera: Eulophidae) was first described in 2003 in Taiwan. Originally from Africa, it has moved over 10,000 miles to be detected in Hawaii in 2005 and spread throughout the Hawaiian island chain in less than 6 months.

Biological control insects are being sought in Africa. A final environmental impact statement was completed in 2008 for the release of *Eurytoma erythrinae*. This insect is prolific, long lived and attacks only EGW in host specificity tests. The female wasp host-feeds by puncturing an EGW larva in the gall and drinking a droplet of host body fluid that oozes out after withdrawing its ovipositor. Field releases of *E. erythrinae* were made at 9 sites in native wiliwili stands and 7 sites in botanical gardens throughout Hawaii in 2008. Monitoring is to be conducted monthly to determine overall crown infestation level rating, the presence of the *Eurytoma erythrinae*, and to track its spread.

Asian Cycad Scale on Guam

Cynthia Snyder

Asian cycad scale (ACS) *Aulacaspis yasumatsui* Takagi (Homoptera: Diaspididae) was first detected in Tumon, Guam on *Cycas revoluta*, (an introduced ornamental cycad) and *C. micronesica*, (native) in 2003. ACS was likely introduced on ornamental cycads from Hawaii.

Native to tropical Southeast Asia, its host plants are exclusively cycads (*Cycadaceae, Zamiaceae, Stangeriaceae*). It was reported in Miami, Florida (likely introduced through legal importation of cycads) in 1996. Despite extensive regulatory efforts it quickly spread to 43 of 67 counties and is considered established in Florida.

Cycas micronesia is known locally as "fandang" in Guam. It is endemic to, and the most abundant arborescent (stem diameter > 5") plant on Guam. ASC has no known natural enemies on Guam where wind and weather patterns have facilitated its spread. Warm, humid, year-round climate allows reproduction and migration to proceed unchecked. The annual dry season increases plant stress and aids in crawler dispersal. Infested mature plants can die within 1 year.

In 2004, a permit was requested from USDA APHIS and Guam Department of Agriculture to import *Rhyzobius lophanthae* from Hawaii. In 2005, adult beetles were released and successfully established. By 2007, beetles were controlling scale populations on mature plants throughout Guam. However, the beetles are not effective at controlling scales on seedlings.

In 2007, Asian cycad scale was detected on Rota. *Rhyzobius lophanthae* was released the same year. In 2008, a population was also found on Palau. In 2009, about 50% of populations of cycads on Palau that were surveyed were found to be infested. *Rhyzobius lophanthae* has been released.

Coconut Rhinoceros Beetle on Guam

Cynthia Snyder

In 2007, coconut rhinoceros beetle (CRB) *Oryctes rhinoceros* (Coleoptera: Scarabaeidae) was detected on Guam. Adults tunnel into young coconut leaves causing a V-shaped notch, killing the palm and reducing nut set. Coconut palm mortality reached 50% when CRB was found on Palau in 1942. Impacts include the potential mortality of coconut, betelnut and pandanus on Guam and potential introduction to Hawaii.

Eradication of adults by mass trapping has not been successful and eradication of immatures by sanitation is ongoing. A cooperative project is looking at the potential to import baculovirus of *Oryctes* (OBV), a viral pathogen that occurs in wild populations of CRB on the islands of Malaysia, Indonesia and the Philippines, at an estimated 3 year cost of more than $500,000. Infection by OBV occurs after beetle larvae eat food contaminated with virus. The virus attacks the haemolymph, fatty tissue and mid gut resulting in paralysis. Grubs are killed within 15-20 days of infection and the virus affects the longevity and fecundity of adult beetles.

FIRE AND INSECT INTERACTIONS

Moderator: Bob Cain

This workshop continued the discussion on fire and insect interactions that were introduced in Plenary Session I. Two formal presentations were given, followed by a discussion of research and technology transfer needs led by Dr. Elizabeth Hebertson (USFS FHP R4). Chad Hoffman from the University of Idaho spoke on "Simulating Crown Fire Hazard Following Bark Beetle Caused Mortality" and Dan West, a CSU graduate student working with Jose Negron, spoke on "Mountain pine beetle-caused lodgepole mortality and subsequent fire occurrence in Colorado". Abstracts provided by the speakers are below. Research needs identified by the working group included elucidation of bark beetle and fire relationships in pinyon-juniper and spruce-fir forest types, changes in forest heterogeneity, the role of fire exclusion, and effects of management. The development of web-based tools and trainings are needed to better disseminate and provide information.

Simulating Crown Fire Hazard Following Bark Beetle Caused Mortality

Chad Hoffman, Wildland Fire Program Coordinator University of Idaho

Insects and wildfires are non-independent forms of disturbance which interact across landscapes to determine future forest composition and structure. Understanding these interactions is becoming increasingly important in light of recent predictions of climate change on both disturbance agents as well as the growing concern of uncharacteristic wildfires and the expanding wildland urban interface. Of particular interest to land managers is the effect that bark beetle caused mortality will have on the ability of crown fires to start and spread. To date however there are no experimental studies which have quantitatively characterized crown fire hazard in bark beetle infested stands, and any studies of this nature would be costly. So researchers are left with only simulation and modeling methodologies to investigate this question. Currently there are two major approaches to simulating fire behavior in the United States: those based on empirical and semi-empirical equations and those based on physical laws. Each of these methodologies provides relative advantages and disadvantages which should be considered when designing an experiment. Of particular interest are the differences in how the fuels complex is represented, and the ability of the mathematical methods to consider the fuel/fire interactions with the atmosphere. When the limitations of the mathematical models used in these two approaches are carefully considered in the design and analysis of data they both provide valuable insights into the affects of bark beetle caused mortality on crown fire initiation and spread.

Mountain Pine Beetle and Lodgepole Pine-Fire Interactions in Colorado

Daniel R. West, Graduate Student, Colorado State University, Dept. Bioagricultural Sciences and Pest Management, Fort Collins, CO ; Jose F. Negron, Research Entomologist, Rocky Mtn Research Station, Fort Collins, CO ; Sheryl L. Costello, Entomologist, Forest Health Management, Region 2, Lakewood Service Station, CO; William R. Jacobi, Professor, Colorado State University, Dept. Bioagricultural Sciences and Pest Management, Fort Collins, CO

A need for understanding the interaction between post-epidemic bark beetle stands and subsequent fire occurrence has escalated due to recent unprecedented mountain pine beetle epidemic in lodgepole pine dominated forests of Colorado. Mountain pine beetle *Dendroctonus ponderosae* Hopkins outbreak intensities in the early 1980's resulted in extensive tree mortality across Colorado in several forest types. Two epidemics occurred on the Arapaho and White River National Forests, delineated by Aerial Detection Survey, estimated around 190,000 acres, each with approximately 450,000 individual trees sustaining mortality. Previous mountain pine beetle-caused mortality is generally thought to increase subsequent fire occurrence but this hypothesis has yet to be empirically recorded in the literature. Our objectives were to assess: if a relationship exists between mountain pine beetle outbreaks of the 1980's and subsequent fire occurrence in Colorado; if there is a correlation between associated weather and fire occurrence in mountain pine beetle outbreak locations of the 1980's; and record the temporal occurrence of fires since the 1980's epidemic initiation. We used historic USDA Forest Service Aerial Detection Survey records dating from 1980 to 1990 in conjunction with USDA Forest Service digital fire location records to look for epidemic and fire relationships. Sixty eight maps were scanned to spatially identify *Dendroctonus ponderosae*-caused mortality over the Arapaho, White River and Uncompahgre National Forests from 1980 through 1990. The combined datasets delineate areas containing lodgepole pine dominated forest type, aerially detected tree mortality from *Dendroctonus ponderosae* (1980-1990) and subsequent historic fire ignition locations. During the summer of 2008, we attempted to locate sixty nine ignition points on the Arapaho, White River and Uncompahgre National Forests. Fifty seven fires were located and categorized as lacking or having fuels from mountain pine beetle prior to the ignition. The field assessment was conducted to verify the presence of mountain pine beetle-caused mortality prior to the fire as well as to confirm the location of the recorded fire. Due to forest stand conditions and management activities on the Uncompahgre National Forest, we focused our efforts on the Arapaho and White River National Forests in central Colorado. We found two of 57 ignition points had fuels from the mortality induced by mountain pine beetle prior to the ignition. Ongoing studies will look at field assessments in greater detail. Further research plans include weather attribute analyses and a description of the temporal relationship associated with the ignition occurrence after the mountain pine beetle outbreaks.

Surface and aerial fuels were measured in 2006 and 2007 to assess the fuel accumulations in *Dendroctonus ponderosae* infested and uninfested lodgepole pine stands. In total, 221 plots were established across the Sulphur Ranger District, Arapaho National Forest, Colorado. Fifty one plots were established in uninfested lodgepole pine stands with an additional 68 plots in stands initially infested between 2000 and 2003. An additional 102 plots were established in lodgepole pine stands initially infested from 2004 to 2007. Three modified Brown's planar transects were measured and averaged across each plot. Site characteristics, forest structure, understory, average cover of grasses and forbs and downed woody debris characteristics were measured at each location. We found significant differences in median litter depth between the uninfested and recently infested plots (2007-2004) and those plots infested between 2000 and 2003 (1.3 (0.7), 1.3 (0.6), 1.8(0.9) Mg/ha ± Medium Average Deviation, respectfully). Maximum grass and forb height was significantly greater in the plots infested from 2000 to 2003 compared to the uninfested and recently infested plots. We projected 10 and 80 percent mountain pine beetle infested tree fall rates using allometric equations from our measured plots to simulate future fuel conditions. All fuel calculations were used in the Forest Vegetation Simulator – Fire and Fuels Extension (FVS-FFE) to model potential fire behavior and estimated wind speeds necessary to exhibit torching and crown fire type in uninfested, currently infested and projected 10 and 80 percent infested tree fall stands. Significant increases in necessary wind speeds were detected to exhibit individual tree torching fire behavior when 80 percent of the infested trees were felled and added to the surface fuel component compared to the wind speeds needed in the uninfested stands. Across all infested categories a significantly greater twenty foot wind speed is needed to initiate and carry a crown fire in modeled fire behavior. Sixty three percent of the uninfested stands were modeled as crown fire, 19 percent as conditional fire type and 18 percent as passive fire type with no stands modeled as a surface fire type. The current and projected infested stands (10% and 80% infested tree fall) had no more than 2 percent variation between them with a shift from crown fire as the primary fire type to the majority modeled fire type being passive (59%, 59%, 61%, currently infested, 10% infested tree fall, 80% infested tree fall). Surface fire type was reintroduced in the infested plots (12 to 14% of plots) in our model runs, most likely from the removal of contiguous canopy from the mountain pine beetle-caused mortality.

SEMIOCHEMICALS TO SUPPRESS BARK BEETLES: PRACTICAL ASPECTS TO DATE Moderators: Dave Wood and Nancy Gillette

No material submitted for proceedings.

PLENARY SESSION III: FOREST INSECTS AND CLIMATE CHANGE

Moderator: John Lundquist

Few natural or manmade phenomena have ever stirred such widespread scientific and popular interest as climate change. Few doubt that the climate is changing and that many factors in our world will be changing with it, including the dynamics and distribution of insect pests. Speakers at the plenary session described the science that underlies our current knowledge of climate change.

Climate Change and its Effects on Western Forest Vegetation

Jeremy Littell, Climate Impacts Group, University of Washington.

Dr. Littell made the following points:

1) Uncertainty about impacts of climate change on forests is not the only barrier to adaptation to climate change, nor is it necessarily the biggest. Barriers to adaptation include scientific uncertainty, but are comparable now to institutional barriers at multiple levels including the will to change (and rate of change) in management agencies, legal/regulatory barriers based on past environments and mandates, and resource limitations.

2) Climate change will have four main impacts in forests: Changes in tree growth, productivity, and carbon uptake; changes in species biogeography and forest composition; changes in disturbance rate, severity (fire, insects, pathogens); and changes in forest hydrology and ecohydrology.

3) Water balance deficit is the difference between atmospheric demand for water (potential evapotranspiration) and the water available to satisfy that demand (actual evapotranspiration). Deficit is related to tree growth, species distributions, host tree vulnerability to insect attack, fuel moisture and fire activity, etc.

4) Changes in tree growth due to climate change will be place- and species- dependent. Future climate change (likely increases in temperatures across seasons, moderate increase in winter precipitation, potentially slight decrease in summer precipitation) will likely cause growth increases at high elevations and in wetter forest types but decreases at low elevations and in drier forest types. At middle elevations, the future impact is likely to depend on whether summer precipitation increases and whether CO_2 induced water use efficiency compensates for increased potential evapotranspiration.

5) Species biogeographical ranges will change, with each species' response determined by its unique requirements, tolerances and interactions between climate, life history, physiological tolerances, and phenology. We should not expect vegetation classes or types to move wholesale, particularly since paleoecological data suggest they have not done so in the past.

6) Future species models that take only climate into account should be used as guides to change, not necessarily as forecasts - many other factors (competition, invasive species, seedling tolerances, changes in disturbance) modify these projections locally.

7) Fire in the Pacific Northwest is controlled at least as much by climate as it is by management. The area burned by fire in this region (WA, OR, ID. MT) is statistically, significantly related to summer water balance deficit, and the relationship is non-linear. Future area burned is likely to double or even triple by the 2040s or at latest 2080s.

8) Relationships between mountain pine beetle and climate suggest increasing elevation of adaptive seasonality (where populations can be epidemic due to one life cycle per year). Much of the pine forests in the mountainous part of the state will be "traversed" by beetle populations between now and the 2080s.

9) Disease mechanisms are similar to insect mechanisms - expected climate changes both increase host tree vulnerability and decrease natural limitations on diseases, so future disease impacts may be significant.

10) Adaptation needs point directly to many research and monitoring needs. This should be the focus of new research.

Effects of Forest Insects on Climate Change

Jeff Hicke, Assistant Professor, Department of Geography, University of Idaho.

Dr. Hicke made the following points:

1) Disturbances, including insect outbreaks, initially reduce tree growth and increase decomposition of organic matter. Both increase the net carbon flux from the forest to the atmosphere

2) As time since disturbance increases, the net carbon flux switches from a brief but strong pulse of carbon to the atmosphere to a longer but weaker sink of carbon by the forest

3) Several insect outbreaks are large enough in extent to suggest big impacts on regional carbon budgets. These include eastern spruce budworm in Canada, mountain pine beetle in British Columbia and the western United States, spruce beetle in western North America; and bark beetles in pinyon pine in southwestern US

4) The spruce budworm and mountain pine beetle outbreaks have had documented large impacts to carbon cycling

5) Carbon stocks will recover to pre-outbreak levels, yet the carbon cycle impacts of these disturbances are important to measure 1) to provide complete estimates for future agreements to limit CO_2 emissions; 2) because increasing frequency of disturbance may lead to a net loss of carbon to the atmosphere; and 3) because forests may not re-grow due to climate change or repeated disturbances

Effects of Climate Change on Forest Insects

Stephen Cook, Associate Professor, Department of Forest Resources, University of Idaho

Professor Cook made the following points:

1) Increasing temperatures have a long history of impacting foliage-feeding insects. There is evidence that as long ago as 59 million years, insect feeding on foliar material increased with increasing temperatures.

2) While we may not know exactly how they will be impacted on a species-by-species basis, we do know that there will be changes in host trees. The distribution of tree species will change as will the community of trees in many locations. From the insect herbivore's perspective, tree phenology, palatability and nutritional content will change with changing climates.

3) Stating the obvious – temperature matters to insects. Insect development rates are temperature dependent and increase with increasing temperatures until they exceed an upper limit and the development rate is retarded by increasing temperatures. Warmer winter temperatures may also result in increased overwintering survival for some species. Less obvious is that warmer winter temperatures may have a negative impact on several forest insects. Some forest insects have a requisite cold period for optimal egg survival. In addition, warmer winters may allow for some parasitoids to have increased activity through the winter. These types of changes could impact insect distributions and overwintering mortality.

4) In addition to the direct impacts of climate change on forest insects and their host trees, there will probably be indirect effects caused by changes in the microbial species associated with some insects such as bark beetles. For example, temperature can determine the prevalence of the fungal species carried by mountain pine beetle populations (Six and Bentz 2007) and it can affect the ability of those fungi to concentrate nitrogen (Cook et al. unpublished).

5) Climate change will probably have other impacts on the overall community of insects by changing biodiversity patterns and community membership and by modifying the ecosystem services provided by insects (i.e. pollination, decomposition, etc.).

6) There will be winners and losers within the community of forest insects. Climate change has the potential to impact many insects (pest, beneficial and economically neutral species) and these impacts will be species specific.

CONCURRENT WORKSHOPS IV:
Panel: BEYOND THE SCIENCE OF CLIMATE CHANGE - WHERE DO WE GO FROM HERE? John E. Lundquist, moderator

Several management coping strategies for addressing the anticipated impacts of climate change have been proposed. Since unprecedented conditions are facing those who must make decisions, most of these proposed strategies are based on little more than logic and good sense alone. Speakers in the plenary session that preceded this workshop illustrated some of the science that underlies climate change predictions. The objective of this workshop was to explore what actions are being taken now by management agencies to address questions of climate change – what they expect, what they feel they should or can do, and what they are planning.

Our panel included representatives from a range of management levels, research, and federal and state agencies. Panel participants included:
Larry Yarger, Deputy Director, Forest Health Protection, USDA Forest Service, Washington Dc
Mary Ellen Dix, Forest Entomology Research National Program Leader, Research and Development, USDA Forest Service, Washington DC
Jerry Beatty, Director, Western Wildland Environmental Threat Assessment, USDA Forest Service, Prineville, OR
Steve Patterson, Assistant Director S&PF, Region 10, USDA Forest Service, Anchorage, AK
Karen Ripley, Forest Health Program Manager, Resource Protection Division, Washington State Department of Natural Resources, Olympia, WA
Lee Pederson, Forest Entomologist, Forest Health Protection, Coeur d' Alene, ID.

After 5-minute introductory remarks by each panel member, the floor was opened to audience questions and comments. A lively discussion followed and the following points were noted:

Larry Yarger mentioned that the US Forest Service has developed a strategic framework that will help guide the agency's actions to address climate change. The framework "Forest Service Strategic Framework for Responding to Climate Change" has seven (7) Goals: Science, Adaptation, Mitigation, Policy, Sustainable Operations, Education and Alliances.

Larry explained that implementation of the strategic framework is supported by seven teams that will focus on seven initial steps in the areas of Science/Management Integration, Monitoring, Adaptation Priorities, Mitigation, Sustainable Operations, Education, and Alliances. "Policy" (Goal 4) is not included as an action for the "first steps" since many policies and programs will be formed by the work of the implementation teams.

Larry further mentioned that the USFS Forest Health Protection (FHP) is beginning to include guidance on addressing climate change in its annual program budget direction to field units. Currently, guidance centers on detection and documentation of changes in forest health that could be attributable to climate change and establishing climate change as a focus area for forest health monitoring evaluation projects. FHP is also developing a strategic plan for conserving the genetics of butternut, ash, hemlock and 5-needle pines. In additional, to addressing climate change in annual program directions, the Forest Service out year budget process will begin to include agency actions to address climate change. For further information, see http://www.fs.fed.us/climatechange/message.shtml.

Mary Ellen Dix discussed the Forest Service Global Change Research Strategy 2009-2019 and its relationship to the National Forest Service Global Change Strategy. She first explained the research strategy links to Goal 1 of the "Forest Service Strategic Framework for Responding to Climate Change". This goal focuses on science to advance our understanding of the environmental, economic, and social implications of climate change and related adaptation and mitigation activities on forests and grasslands. The strategic framework identifies the following aspirations for Goal 1:

- The Forest Service is recognized for world-class scientific information and tools regarding forests and grasslands and their relation to climate change.

The Forest Service demonstrates excellence in the delivery of science findings and tools to users and in the application of science to land management problems in climate change.

Mary Ellen mentioned that the Forest Service Global Climate Change Research Strategy 2009-2019 is organized into the following elements:

- Research to Enhance Ecosystem Sustainability (Adaptation): This element focuses on research that will advance management options under a changing climate to enhance ecosystem health and sustainability; ensure the flow of ecosystem services, such as water, wildlife, biodiversity, recreation, forest and grassland products; and reduce losses of ecosystem function from climate-altered disturbances, such as wildfire, insects, and invasive species.
- Research to Increase Carbon Sequestration (Mitigation): The second element focuses on research that will assist managers in (a) enhancing carbon sequestration via actions that could increase forest growth rates and area of forested lands; (b) enhancing biomass extraction and utilization research; and (c) understanding long-term carbon product storage pools. These capabilities cannot be realized without the sustainability being supported by research for the first element.
- Research to Provide Decision Support: The third element integrates the first two research elements by developing decision-support tools and approaches for policymakers, planners, and land managers.

Shared Research Needs: Infrastructure, Scientific Collaboration, and Science Delivery: The fourth element is focused on the shared research needs for infrastructure, scientific collaboration, and science delivery that will incorporate the research and applications in the first three elements into natural resource planning and manage

For more than 20 years, Forest Service scientists have conducted research on the possible impacts of climate change on forests and rangelands in the US and the development of adaptation and mitigation strategies. This research includes continuous research on assessments of climate change, its impacts and subsequent consequences to natural resource management. The long term research, scientific information, and tools produced by this research can be used by managers and policymakers to address climate change impacts to forests and rangelands. Decisions being made today by public and private sector resource managers based on this research will have implications through the next century.

Jerry Beatty explained that working with partners and cooperators, the Western Wildland Environmental Threat Assessment Center (WWETAC) is developing a suite of coordinated research, synthesis, and technology transfer activities. Focus will be on the generation and integration of knowledge and information regarding the effects of climate change on wildland resources in the western United States. He emphasized that the Threats Center is specifically interested in climate change synergisms, that is, the integration of climate change with other wildland threats such as insect and disease outbreaks, invasive species, fire, and land-use change across multiple spatial and temporal scales. He expanded on this point as follows:

- Objective 1: Generate and integrate knowledge and information to provide credible prediction, early detection, and quantitative assessment of climate change in the western United States. Jerry mentioned that the reasoning behind this objective is that climate change impacts have been and are being observed across western wildands and additional changes have the potential to significantly affect western wildland resources and ecosystem services. Land managers, policy and decision makers require information to anticipate likely outcomes and take action to prevent or ameliorate the effects related to climate change.
- Objective 2: Facilitate development of tools to assess and quantify climate change synergistic effects on natural resources and ecosystem services at scales relevant for forest management and planning. According to Jerry, models are currently available that can be used to predict the effects of climate change and insect and disease outbreaks on wildland resources. However, these drivers operate simultaneously, and inherent interaction at multiple scales and feedbacks are occurring. He explained that those at the WWETAC are proposing three projects to facilitate tool development to assess and quantify climate change and pest interactions at multiple scales.

Objective 3: To assist with the delivery of climate change and climate change synergism assessment products and tools through a variety of user-friendly technology transfer mechanisms useful to land managers. Climate change research has become a priority issue and WWETAC, PNW, and the FS need to respond broadly and quickly. Effective knowledge management is critical. The training/education needs for public land managers are large and urgent. WWETAC has a central role and can coordinate a comprehensive series of resources and events to achieve effective education of the FS workforce in climate change. However, this component needs to be built into a framework that includes all relevant topics and a variety of training modalities. WWETAC, in coordination with the Westwide Climate Change Initiative, will work to design courseware that uses this new and efficient means of real-time, on-demand training and collaboration.

Steve Patterson was asked about his Forest Health Protection group in Region 10, Alaska, and what regional level folks are doing about climate change. He explained that his is a small staff of 10 permanent employees which monitors forest health conditions and provides technical assistance to landowners and managers across a huge geographic area of 129MM acres of forested land. In February, 2007, his group launched a strategic planning process, facilitated by a contract professional, which was inclusive of our stakeholders. One of the three strategic goals that emerged out of the process was Climate Change (the others were Early Detection, and Communication).

A common recognition among stakeholders is that climate change impacts are already observable in Alaska and will likely intensify. Alaska will experience many of these effects prior to the lower 48 states – “canary in the coal mine”. Insects and diseases will likely respond to the changed environment and stress vegetation and thus play an early and key disturbance role in ecosystem responses. Invasive insect-, disease-, and plant-introductions and establishment also will pose a large threat to ecosystems, especially in the northern boreal forests with large stands and relatively low tree composition diversity.

Steve further mentioned that Region 10 FHP is currently involved in many projects that deal with climate change. He listed some of these projects:

- Latitudinal Transect – monitor and study phenology of insect guilds and bio-indicators of climate change along a north/south area from Seward toward Prudhoe Bay; eventually established this transect as a long-term monitoring network.

- Yellow-Cedar Decline – continue to build on recognition of effects of lack of snow coverage leading toward a possible conservation strategy.

Early Detection Rapid Response

Cooperative efforts with the University of Alaska at Fairbanks Cooperative Extension Service partners (CES) using Integrated Pest Management techniques and a continuum of partners, including citizens observations, trained pest scouts, Alaska entomologists, and resources of the Western Plant Diagnostic Network

Cooperate on a proposed State & Private Forestry Redesign project that will likely be funded: State of Alaska Division of Forestry Non-Native Insects

- National Insect and Disease Risk Map 2010 – we are working with PRISM data and new data bases to facilitate incorporating climate change into the projections

Investigating theories of climate effects relative to:

spruce aphid effects in southeast Alaska
budworm defoliation in interior Alaska
alder and Salix sp. mortality in southcentral Alaska

Participation on the Governor's Climate Change Technical Work Group

Steve listed several web-based and other reference sources that describe his group's program and many of the projects listed above:
http://www.fs.fed.us/r10/spf/fhp/

R10 FHP Strategic Plan
Alaska Latitudinal Transect Poster (WFIWC, 2009)
Yellow-cedar Decline
Four Years of Early Detection Rapid Response Insect Trapping in Juneau, AK
Use of PRISM –
http://www.fs.fed.us/r10/spf/fhp/cedar/pubs/EM_cedar_mt_edgecumbe_year_2_v2_webqual.pdf

Steve also mentioned some of the major cooperative agencies web references:
Cooperative Extension Service (IPPM; http://www.uaf.edu/ces/ipm/index.html)
Alaska Division of Forestry Non-Native Insect project proposal(http://www.wflcweb.org/spf grants 09/Alaska/Alaska Non-natives.pdf

State of Alaska – Climate Change Technical Working Group. http://www.climatechange.alaska.gov/aag/aag.htm

Karen Ripley offered a description of the climate impacts and assessment activities in Washington State. She mentioned the following:

- Recent policies commit Washington State to reducing carbon emissions. Governor's Executive Order 07-02 (http://www.cted.wa.gov/DesktopModules/ CTEDPublications/ CTEDPublications-View.aspx?tabID=0&ItemID=4077&MId=863&wversion=Staging) describes that by 2020, Washington will reduce carbon emissions to 1990 levels; by 2035 to 25% below 1990 levels; and by 2050 to 50% below 1990 levels. This will mostly be accomplished by reducing emissions from transportation fuels. There are also Carbon "Cap & Trade" bills (SB5735 and HB1819) in the state legislature right now. This is not popular in tough financial times, and is perceived as a "job-killer". It was recently amended to be a 2 year "study" bill, but the governor continues to seek to restore at least the "cap" part. The legislature adjourned at the end of April, 2009.
- In 2008, the Legislature commissioned the Climate Impacts Group at the University of Washington to assess the likely impacts of climate change. They combined two carbon emissions scenarios with 20 different climate models and averaged the output to determine the likely scale of future changes. For

example, the models project increases in annual temperature of, on average, 2.2ºF by the 2020s and 5.9ºF by the 2080s (compared to 1970-1999). Then teams of subject experts (Hydrology & Water, Energy Supply & Demand, Agriculture, Salmon, Forestry, Coasts, Urban Stormwater, Human Health) evaluated those climate scenarios for implications in their areas.
In Forestry, the area burned by wildfire is projected to double or triple by the 2080s; mountain pine beetle outbreaks are projected to increase; over time the area of habitat with climate ranges suitable for mountain pine beetle is likely to decline; the area where the climate is suitable to support mature lodgepole pine or Douglas fir are likely to decline; and the area of severely water limited forest is projected to increase. The final report is available at: http://cses.washington.edu/cig/res/ia/waccia.shtml

- Washington also has established "Preparation and Adaptation Working Groups" (tribes, landowners, industry, environmentalists, energy producers, local government) devoted to making recommendations regarding adaptation to climate change. Their main recommendations for forestry included: Keep forested areas in forest; Increase urban reforestation; and Manage forests to increase carbon storage in forests and/or in long-lived wood products. They recommend implementing fuel reduction treatments on 25% of the forest acres identified as being at high-risk of catastrophic wildfires by 2020, with the long term aim of treating all such acres by 2050." (Leading the Way on Climate Change: The Challenge of Our Time. Feb, 2008. Washington State Dept of Ecology Publication #08-01-008). These are an excellent compilation of ideas, but have no implementation plan or requirement. The work itself will be challenging because there is not agreement on where the high risk acres are, nor is there infrastructure or markets for dealing with the low value wood products that should be removed, and the most inexpensive way of dealing with the waste material (burning) presents clean air challenges and does not replace fossil fuels (as it could if the material were to contribute to bioenergy). There are some energy production facilities in Washington that use wood waste, but they are few and generally distant from forest sources of wood waste.
- There is a bill in the Legislature now (ESB 5138) that would require the state to develop an integrated response strategy to climate change by December 2013. It would likely be based on implementing the ideas described above in the previous bullet. Funding implementation activities is a huge challenge.

With responsibility for providing forest health technical assistance to state and private forest landowners and managers, I feel that we (State Forest Entomologists and Pathologists) are really behind the curve. There is still a lot of skepticism about whether climate change exists – which should be put to rest. Although we already know many techniques for increasing forest resiliency, we are challenged (economics, social) to implement them now. Moreover, we need both the climate folks and silviculturists/tree physiologists to assist in developing appropriate guidance and action recommendations on the magnitude of changes to expect within the next tree rotation in order to inform/stimulate the creativity of forest landowners and managers towards robust solutions about what to plant now and how to manage it over time.

Lee Pederson explained that Region 1 has responded to the national level Forest Service Strategic Framework for Responding to Climate Change through a series of presentations, discussions, and by developing a region level strategy documented in Climate Change Strategy by the Ecosystem Management Team. Lee mentioned that this effort is especially timely for the IPNF and Kootenai National Forests in Region 1, as they are currently working on Forest Plan revisions. He specifically mentioned the following:

- In April 2008, an Integrated Restoration and Protection Strategy workshop was organized; scientists and regional specialists gathered in Missoula to present and discuss climate change issues and possible implications for the national forests and grasslands.
- In June 2008, the Region 1, Regional Leadership Team identified a need for coordinating and identifying actions to better position the Region in their response to climate change. The R1 Ecosystem Man-

agement Team took on the task of developing a Northern Region Climate Change Strategy that consists of a Climate Change Action Plan. The Priority Action Items in the Plan include (and these items are closely aligned with the Forest Service's National Framework):

- Communication and coordination -- Facilitate effective Regional Leadership Team and Forest Leadership Team communications on, and involvement in, climate change policy issues and regional actions.
- Support to planning and decision-making -- Support efforts to incorporate climate change considerations into forest planning.
- Acquire needed knowledge, information, and decision support tools -- Acquire and summarize best available information on regional climate trends and projections.

- In October 2008, the Rocky Mountain Research Station organized and conducted four climate change symposiums called "Science Days." One of each was held on the IPNF, Kootenai, and Custer National Forests, and the Dakota Prairie Grassland. Lee mentioned that he gave a presentation on forest insects and climate change (main focus on bark beetles) at the IPNF and Kootenai symposiums. Other speakers included: Dave Peterson, PNW research station, Jeremy Littel: Climate Impacts Group (U. of Washington); and Kevin McKelvey: RMRS, terrestrial wildlife.
- In October 2008, the Greater Yellowstone Coordinating Committee (Beaverhead-Deerlodge, Custer, and Gallatin NF's) met to discuss climate change.
- In December 2008, a multi-agency meeting involving the Lewis and Clark, Lolo, and Flathead National Forests and Glacier National Park met to discuss climate change and possible management strategies.
- In January 2008, a "Draft" website titled the Climate Change Resource Center (CCRC) was produced by the Region 1 office. This is a website for resource managers and decision-makers who need information and tools to address climate change in planning and project implementation on western forest lands. The intent was not to reproduce information on the site, but guide by directing to resources via links. A cornucopia of sources and information is presented on the website. It also provides climate change info specific to R1 efforts.

CAN STATE & FEDERAL AGENCIES EFFECTIVELY RESPOND TO INVASIVE SPECIES? YES, WE CAN!

Moderator, Ron Billings, Texas Forest Service

The goal of this workshop was to discuss current programs, challenges and successes of provincial and state forestry agencies in British Columbia, Oregon and Texas in dealing with invasive species. Each speaker was asked to address the following questions:

What are the most important invasive species that your agency is currently addressing (Top 2-3)?
What is your agency doing to deal with the number 1 problem?
How does your agency foster interagency cooperation as it relates to invasive species?
What lessons have you learned about successfully addressing invasive species?

A summary of each presentation is provided below.

Critical Plant Pest Response in British Columbia

Jennifer Burleigh, Provincial Forest Entomologist, BC Ministry of Forests, PO Box 9513, Stn Prov Govt,Victoria, BC V8W 9C2. JenniferBurleigh@gov.bc.ca

The detection, regulation and eradication of introduced pests to Canada lies within the jurisdiction of the Canadian Food Inspection Agency (CFIA). While eradication of introduced pests is a federal responsibility, provincial ministries are often involved in eradication programs due to their increased capacity and expertise in carrying out treatment programs.

Having multiple agencies (both federal and provincial) with overlapping mandates and different objectives can lead to confusion over roles and responsibilities during the critical period leading up to an eradication program. In response, British Columbia established the Plant Protection Advisory Council (BC PPAC) in 1973. The primary goals of this council are to clarify the positions of provincial and federal agencies, to foster communication between agencies affected by changes to legislation, quarantines or other practices and to form technical species specific committees when required. Members of BCPPAC include employees of Agriculture & Agrifoods Canada (AAFC), CFIA, Canadian Forest Service (CFS), Ministry of Agriculture & Lands (MAL), Ministry of Forests & Range (MFR), various grower associations and universities.

The Gypsy Moth Committee was one of the first two technical committees formed under BCPPAC. Members of the committee meet in the fall each year to evaluate the results of detection trapping, treatment program success and to discuss treatment programs for the subsequent year. While NA gypsy moth is established in eastern Canada, BC remains gypsy moth free. In 1998 CFIA decided to no longer carry out eradication programs anywhere in Canada since there were established populations in the east, but would maintain their population trapping grids and regulatory/quarantine zones. However, due to the ecological and economic implications of becoming a regulated area for gypsy moth, BC MFR continues to implement eradication programs within our provincial borders. The Gypsy Moth Committee is integral in maintaining effective, collaborative and successful eradication programs in the province.

The federal government along with provinces and territories have been developing a National Forest Pest Strategy (NFPS) to create a common, science-based framework to assess the threat of forest pests (native and invasive), to provide integrated advice to decision makers at all levels of government, to implement appropriate responses and to effectively communicate information and results. Implementation of this strategy in BC draws heavily from our BCPPAC experience, which has been used as a model in other provinces.

Invasive Species in Oregon: Status, Trends and Policy

Rob Flowers, Oregon Department of Forestry, Salem, OR, rob.flowers@state.or.us with contributions from Lisa DeBruyckere, Oregon Invasive Species Council, Portland, OR

The Oregon Invasive Species Council (OISC) was created by the state legislature in 2001, and coordinates efforts to keep invasive species out of Oregon and mitigates the impacts of those already established. OISC's primary role is to assist in coordinating the various government agencies, universities, and non-profit organizations involved in these issues. Currently, state funding provides only for an OISC coordinator position, which oversees an advisory committee on invasive species that is made up of volunteer representatives from many organizations. They also conduct public outreach and fundraising efforts. A "state of the state" review of invasive species in Oregon revealed recent successes as well as continued challenges. Highlights include the successful eradications of the granulate ambrosia beetle (*Xylosandrus crassiusculus*) from an industrial area, and small populations of European gypsy moths (*Lymantria dispar*) at a number of locations around the state. Ongoing challenges include continued treatments of areas in southwest Oregon that contain the pathogen that causes sudden oak death (*Phytophthora ramorum*), as well as a number of newly detected organisms with the potential to cause substantial damage to both terrestrial and aquatic ecosystems in Oregon.

Of the twenty most recently detected non-native invertebrates in Oregon, nineteen of those have resulted from deliberate, organized surveys, while only one was the product of public reporting. These findings highlight the need for continued "early detection" programs as well as further expansion of surveillance for high-priority areas or species. Recent invaders appear to have originated from at least eight countries on four continents, with the majority arriving via human transport/shipping to industrial areas and ports or into existing population centers. Projected losses to the state due to the impacts of only a small number of invasive species are estimated at over $400 million, a substantial sum in comparison to the relatively low expenditures needed to conduct interception programs and fund ongoing eradication/treatment efforts.

The current focus of OISC includes both a statewide publicity campaign as well as the development of a comprehensive business plan. Highlights of the statewide campaign include the publishing of an annual "100 worst invaders" list as well as the production of an award-winning Oregon Public Broadcasting documentary entitled "The Silent Invasion." In addition, public events included an "invasive species day" at the state Capitol as well as the first annual "invasive species summit." These events were pivotal to the creation of an OISC business plan, which focuses on improving communication and coordination among stakeholders, achieving long-term sustainable funding, producing new legislative concepts, and raising public awareness on invasive species. More immediate goals include the development of a "statewide assessment" and database of invasive species, increased partnering with nearby states/countries to address pathway issues, and the passing of new or revised legislation. Current year funding requests include the creation of an "emergency fund" for quickly responding to new detections, expanded surveillance for aquatic invasive species, and funds for sustaining treatment efforts for high-priority invasive species that are not yet established. Public awareness on these issues has been greatly increased of late by displays at a number of public events and venues in addition to the development of educational materials for public agencies and schools.
For further information, please see the following:

Oregon Invasive Species Council: http://www.oregon.gov/OISC/
Oregon Department of Agriculture, Insect Pest Prevention and Management: http://oregon.gov/ODA/PLANT/IPPM/program_overview.shtml
Granulate Ambrosia Beetle Success Story: http://www.fs.fed.us/r6/nr/fid/invasives/success/gab.shtml
Oak Mortality Task Force: http://www.suddenoakdeath.org/
OPB Silent Invasion Documentary: http://www.opb.org/programs/invasives/
Oregon Invasive Species Hotline: www.oregoninvasiveshotline.org

Emerging Invasive Pests in Texas

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Traditionally, Texas has been most concerned about native pests, particularly the southern pine beetle in East Texas and oak wilt in Central Texas. In recent years, however, attention of the Texas Forest Service (TFS) has been drawn to invasive insects, diseases and plants. Among the more important invasive insects of concern are the Asian gypsy moth, the soapberry borer (*Agrilus prionurus*), *Sirex* woodwasp and the emerald ash borer. The latter has been detected in Missouri and is expected to show up in Texas eventually. The soapberry borer, of the same genus as the emerald ash borer, is a native of Mexico that has been detected in numerous counties and urban areas of Texas. It infests and kills western soapberry (*Sapindus saponaria* var. *drummondii*), a tree species that extends from Texas to Missouri and west to Arizona. Little is known about its biology or methods of control.

Among invasive plants, cogongrass, kudzu, Japanese climbing fern, Chinese tallow, and Chinese privet are of greatest concern. To address invasive plants, TFS initiated the Pulling Together Initiative, a collaborative project between the Texas Forest Service, the USDA Forest Service, Forest Health Protection, Region 8, and the Lady Bird Johnson Wildflower Center in Austin. Each participant brings a unique set of skills to meet the goals and objectives of the partnership. Accomplishments in the last 5 years have been considerable.

1. Organized and hosted the first and second conferences in Texas on non-native invasive plants.
2. Established an Internet webpage (www.texasinvasives.org) as the state's primary resource for invasive species information and resources.
3. Created a statewide invasive plant database with biological, distributional, ecological and management information on over 130 species.
4. Prepared and published several fact sheets and articles on important invasive insects (emerald ash borer, soapberry borer, Asian longhorned beetle, gypsy moth) and invasive plants (Chinese tallow, kudzu, Japanese climbing fern, Chinaberry, Japanese honeysuckle, giant reed, Chinese and European privet, tropical soda apple) to increase public awareness of these existing or potential pests in Texas.
5. Conducted a statewide survey of national and state parks, natural areas, and preserves to document the distribution and impact of selected invasive plants and to identify potential demonstration areas for best practices in invasive plant diagnosis and management.
6. Organized and trained a cadre of 460+ citizen scientist volunteers in 24 different regions of Texas to detect and report invasive plant species. Once trained, citizen scientists detect invasive plants and send in a description and digital photo to the LBJWC for verification, before the location is published on the invasives web page.
7. Initiated eradication of the only known infestation of cogon grass in East Texas.

To increase cooperation among eight state agencies (including TFS) with regulatory or administrative authority for invasive species in Texas, the Texas Invasive Species Coordinating Committee (TISCC) was formed in 2007. Other public and private stakeholders are members of a non-regulatory organization, the Texas Invasive Pest and Plant Council (TIPPC). In addition, the Forest Health Task Force was formed in 2007 to provide input to the Southern Group of State Foresters on all matters of forest health in the South, including invasive species. Each southern state forest pest management specialist, and two entomologists with the US Forest Service (Research and Forest Health Protection) are members of this task force. Increasing public awareness of invasive pests and promoting collaborative efforts are recognized as important first steps in dealing with the new challenge of invasive species at the state level.

CONE AND SEED INSECTS

Moderators: Ward Strong (lead) and Robb Bennett

This open discussion, round table format workshop attracted around 30 participants representing cone and seed insect interests in Sweden, Alberta, British Columbia, and a wide variety of States from Louisiana and California to Idaho and Washington. Participants focused their discussion on the following brief presentations:

- *Dioryctria*: Biology, life history, treatment (Dan Miller, USDA FS, Athens GA)
- Living in a degree-day world: degree-day summation as a management tool (Jim Corrigan, BC MoFR, Vernon BC – see abstract below)
- Pesticides in cone & seed pest management: New chemistries (Alex Mangini, USDA FS, Pineville LA – see abstract below)
- Advances in *Leptoglossus* research (Ward Strong)
- Identifying research needed to fill in the gaps in seed/cone insect biology (Beth Willhite, USDA FS, Sandy OR).

Dan Miller discussed *Dioryctria* coneworm issues based on experiences with serious damage to cones and conelets of southern USA pines. Multiple species of *Dioryctria* appearing at varying times and often having multiple generations have resulted in application of 3-5 sprays per year. Spray timing has been worked out for *D. amatella* but little has been done with the large array of other species. Much work needs to be done on biology, basic identification (especially with the problematic *D. zimmermanni* group), and management of lab colonies (diet, rearing, photoperiod, mating, etc.), among other issues.

Even taxonomic limits are not well worked out for various species. It is apparent that some species use multiple overlapping generations as a biological strategy. Emamectin benzoate stem injections have proved effective for control in Texas (see Mangini abstract). Gary Grant (CFS, Sault Ste Marie ON) is working on *Dioryctria* pheromones (e.g. *in press* publication on pheromonal differences between eastern and western North American populations of *D. abietivorella*). Some molecular work (microsatellites, morphometrics) is underway.

Jim Corrigan followed with a description of, and request for input regarding, his development of a degree day based management tool. Participants agreed that the project is interesting work in its infancy in conifer seed orchards and the results should increase the accuracy of biological predictions made by orchardists. System appears to be relatively simple and, after several years of accumulation of data, should show site-specific patterns for accurate prediction of activity of specific insects and timing of pollination period.

Alex Mangini outlined current efforts for registration of new products for cone and seed insect management. Because of the relatively small acreage devoted to cone and seed production, new registrations for use in our industry are difficult to achieve. In a move away from old-style broad spectrum, highly toxic chemicals, a new generation of products look to be much more environmentally sensitive. Pesticide-related issues were discussed: human factors (e.g., worker exposure rates, proximity of many sites to urban areas), economic factors associated with forced seed production (i.e., should we be trying so hard to produce crops in "off-crop" years, what levels of damage can be accepted, and how do we set reasonable damage thresholds?), and "self-inflicted wounds" (creation of pest problems through poor pest management practices).

Ward Strong outlined on-going research in British Columbia on *Leptoglossus* seed bugs. Gerhard Gries and colleagues at Simon Fraser University have shown that seed bugs use infra-red wavelength cues to find cones. This is the first demonstration of this ability in an herbivore and the ability is now being looked for in other cone and seed insects. Gries *et al.* are also developing a seed bug trap utilizing IR and visible wavelengths reflectance as well as size variables. Staffan Lindgren (University of Northern BC), Sylvie Desjardins (University of BC Okanagan), and their colleagues are using mark/release/recapture techniques to study various aspects of seed bug behaviour. An interesting spin-off from this work has been confirmation that seed bugs do exhibit distinct clonal preferences; discussion focused on the possible basis for this (variation in temperature and terpene constituents as well as other factors).

The final discussion (research needs) was led by **Beth Willhite**, based on the results of a survey sent out to orchardists and researchers in BC, ID, WA, and OR prior to the WFIWC meeting. Douglas-fir and Douglas-fir cone gall midge (*Contarinia oregonensis*) were ranked #1 for host/pest issues and pest research needs respectively. Other cited needs were: research on environmentally benign management options; seed bugs; pheromones; basic taxonomy; natural enemies; and improving existing IPM strategies. Gall midge pheromone work is scheduled to restart at Simon Fraser University in 2009 (pending funding availability). BC Ministry of Forests staff are developing a series of cone and seed insect PDF fact sheets in collaboration with photographer Dion Manastyrski and entomologist Julie Brooks – these should be useful to orchardists throughout the Pacific Northwest. Dispersal of cone and seed insect pests was noted as an under-researched issue.

Abstracts

1) Pesticides in Cone and Seed Pest Management: New Chemistries

Pesticides are an integral tool for integrated pest management in North American conifer seed orchards. Insect control is necessary and there is a low economic threshold for damage. Yet, because of the small areas treated, companies are ambivalent about maintaining current registrations and averse to registering new pesticides. Also, recent years have seen greater public scrutiny and official regulation of pesticides.

As a result, it is difficult to maintain the selection of products needed for an integrated pest management program. In the United States, several pesticides were lost to seed orchard use in the last ten years – their registrations cancelled due to concerns about contamination or worker-exposure. Consequently, there is a strong impetus for testing any new pesticide "chemistries" that come to market.

Pesticides can be classified in several ways; classification by chemistry and/or mode of action are perhaps most familiar. The chemistries are numerous. The Compendium of Pesticide Common Names (http://www.alanwood.net/pesticides/index.html) provides a detailed list. New chemistries commercially available include (example in parentheses): macrocyclic lactone insecticides (the avermectins, such as emamectin benzoate), chitin synthesis inhibitors (novaluron), molting hormone agonists (tebufenozide), nicotinoids (imidacloprid), oxadiazines (indoxacarb), thiazoles (thiamethoxam), and, one of the newest, the anthranilic diamides (chlorantraniliprole). These new pesticides act as either physiological toxins or physiological disruptors (growth regulators).

These new chemistries have the advantages of potency, safety and specificity. Little chemical is introduced into the environment; impact on birds and mammals is slight, and damage to non-target and beneficial arthropods is minimal. Consequently, these products make good additions to integrated pest management in conifer seed orchards. And, importantly, they are less likely to be of concern to the Environmental Protection Agency (EPA) and other state and provincial agencies. At present, the primary disadvantage, relative to conventional insecticides, is cost.

Tests of several of these products have been done in pine seed orchards in the southern United States. USDA Forest Service, Forest Health Protection has done pilot tests for coneworm and seed bug control from 2000 through 2008. Indoxacarb, imidacloprid, novaluron, tebufenozide, and thiamethoxam have been evaluated. These pilot tests used a single orchard and a 36-ramet (18 treated, 18 control) design. Indoxacarb was effective against both coneworms and seed bugs. Tebufenozide controlled coneworms and is now used operationally throughout the South. Chlorantraniliprole will be evaluated in 2009 in a two-orchard test in cooperation with the Texas Forest Service. Significantly, in tests done by the Texas Forest Service, emamectin benzoate demonstrated strong efficacy against coneworms when applied as a systemic via trunk injection. The product/injection methodology is currently in the EPA registration process.

2) Living in a degree-day world: degree-day summation as a management tool (Jim Corrigan)

For many poikilothermic organisms, there is an inverse linear relationship between temperature and the time it takes for them to reach important developmental milestones in their life cycles. The recording of accumulated heat units, often called Growing Degree Days (GDD), can allow for better prediction of the timing of these biological milestones relative to predictions made by using calendar days. GDD accumulations are widely employed as predictive pest monitoring tools in many cropping systems. However, the slope of the temperature/development relationship and the threshold temperatures for development are unique for each species. Operationally, these relationships are established on a species-by-species basis. However, this work can be time consuming and expensive and it has not been done for many species of interest in conifer seed production.

In 2008, temperature and GDD recording equipment was installed at each of ten seed orchard locations in the Interior of British Columbia. In this Workshop, we will discuss the use of 'generic' developmental thresholds for a multi-species suite of seed and cone pests (lower – 5^{o}C; upper 35 ^{o}C). Will such generic thresholds produce accurate operational predictions? Are the chosen developmental limits reasonable-ideal to achieve accurate prediction of pest phenology? Should GDD values be accumulated from January 1 or should the recording units be turned on at a time closer to the beginning of the growing season? If an attempt is made to synchronize data recording with the onset of the real biological season, what date should be chosen as a time to turn on the recording units?

CONCURRENT WORKSHOP V

POTENTIAL IMPLICATIONS OF INTERNATIONAL ENTOMOLOGICAL RESEARCH TO NORTH AMERICAN FORESTS

Moderator: Nadir Erbilgin, Dept. Renewable Resources, Univ.of Alberta, Edmonton, Canada

As increasing international trade has resulted in an ever-increasing arrival and establishment of alien species in new parts of the world, research conducted in different countries or continents is invaluable for understanding of the potential risks associated with several exotic insect pest species in other regions. In this workshop, presenters demonstrated some of their research conducted in different regions of the world and critically evaluate potential implications of their results to future and stability of North American forests.

In first presentation titled ***"Investigations of an apparently undescribed species of Dendroctonus bark beetle in southern Mexico"*** by Brian T. Sullivan (USDA-FS, SRS, Pineville, Louisiana), Jorge Macias (El Colegio de la Frontera Sur (ECOSUR), Tapachula, Chiapas, Mexico), Alicia Niño (ECOSUR, Tapachula, Chiapas, Mexico), Benjamin Moreno (ECOSUR, Tapachula, Chiapas, Mexico), and Steve Clarke (USDA-FS, FHP, Lufkin, Texas) identified a mixed population of *Dendroctonus frontalis* and *D. 'woodii'* in the Lagunas de Montebello National Park of Chiapas, Mexico, and in 2006 initiated investigations into the taxonomic status and biology of the putative 'new' species. Several lines of evidence supported their hypothesis that *D. 'woodii'* is distinct from *D. frontalis*: (1) *Dendroctonus frontalis* and *D. 'woodii'* collected from the same trees had distinct cuticular hydrocarbon profiles, (2) measurements from series of seminal rods revealed subtle but distinct morphological character states for each group, (3) in preliminary studies, forced crosses between *D. 'woodii'* and *D. frontalis* produced significantly fewer F1 larvae than non-mixed pairings, (4) natural attacks by *D. 'woodii'* were concentrated at the bases of trees whereas *D. frontalis* attacks were focused on the mid-bole, and (5) the pheromone blend produced by the two groups differed significantly. Newly-emerged *D. 'woodii'* lacked the large quantities of verbenol and verbenone present in newly-emerged *D. frontalis* females and males, respectively, and attacking female *D. 'woodii'* produced both the female- and the male-produced components of the *D. frontalis* aggregation pheromone (i.e., frontalin and (+)-*endo*-brevicomin). However, trapping studies have not yet revealed bait combinations that discriminate between the two apparently distinct species, and both respond to traps baited with blends of frontalin, *endo*-brevicomin and host odors. Studies using coupled gas chromatography-electroantennographic detection are currently being conducted using a portable instrument housed at ECOSUR, Tapachula (by Ms. Niño), and these may reveal previously unrecognized attractant and/or inhibitory semiochemicals for *D. 'woodii'* that might contribute to niche partitioning and reproductive isolation from *D. frontalis*.

In the second presentation, titled ***"The Boomerang Project: Dendroctonus valens and its Ophiostomatoid Hitch-Hikers"*** by Nancy Gillette (USDA-FS, PSW RS, Berkeley, CA), Min Lu, Jianghua Sun (Inst Zoo, Chinese Academy of Sciences, China), Mike Wingfield (Fac Bio & Agr Sci, Univ Pretoria, Pretoria, South Africa), Don Owen (California Depart For & Fire Protection, Redding, California), Nadir Erbilgin (Depart Ren Res, Univ Alberta, Edmonton, Canada), and dozens of FHP entomologists and pathologists investigated differences in aggressiveness of the red turpentine beetle, *Dendroctonus valens* in North America vs. China where millions of *Pinus tabuliformis* trees have been killed. The researchers developed a working hypothesis that differences in aggressiveness were likely a result of either differences in response to host volatiles (more efficient host-finding in China) or differences in symbiotic fungal associates (greater virulence in Chinese fungal associates). They therefore embarked upon a series of studies, first focusing on apparent semiochemical differences. An extensive series of field assays in China, the US, and Mexico revealed that there really were no significant differences in *D. valens* response to host semiochemicals in these different geographic areas, so they abandoned that hypothesis as an explanation for *D. valens*' invasive success in Asia. They then began sampling *D. valens* fungal associates in both North America and China to test for variations in virulence. Sampling in China showed that *D. valens* has acquired quite a different group of fungal associates there, showing little overlap with its native North American fungal flora. Of the ten species of fungi isolated from Chinese *D. valens*, only two (*Leptographium procerum* and *Ophiostoma ips*) are reported from *D. valens* in North American. Conversely, *L. terebrantis*, the most commonly isolated fungal species in North America, was not found in Chinese *D. valens*. This finding is of real concern because of the risk of reintroduction of *D. valens* into North America carrying exotic fungi that have not co-evolved with native conifers. Finally, preliminary laboratory assays suggest that two strains of *Leptographium* that were isolated in China are markedly more virulent than its congeners in North America, further underscoring concerns about this polyphagous beetle and its rapidly expanding cadre of hitch-hikers. Samples from North America are currently undergoing sequencing for identification and phylogenetic analyses, but morphological identification indicates that the North American fungal flora consists entirely of *L. terebrantis* and *L. procerum*, as expected.

In the third presentation, titled **"*The spruce bark beetle, Ips typographus, successfully established and produced offspring in three North American spruce species in Norway*"** by Nadir Erbilgin, Bjorn Økland and Erik Christiansen (Norwegian For and Landscape Inst, Norway) investigated the role of different North American spruce forests in host and range expansion of an aggressive bark beetle species, *Ips typographus*. The study was carried out in Norway using three of the most common North American spruce species, red (*Picea rubens*), Engelmann (*P. engelmanii*), and Lutz (*P. lutzii*) spruce in addition to the beetle's historical host, Norway spruce (*P. abies*). The objectives of their study were to determine if *I. typographus* can colonize and produce brood on exotic spruce trees and evaluate whether the resulting information would suggest about the potential risk of establishment of *I. typographus* in North America. None of the live trees was killed by *I. typographus* although they sustained extensive beetle galleries. However, mean gallery length, an indication of successful host entry and establishment, was similar between Norway and red spruce, while Engelmann and Lutz spruce had shorter galleries. On the other hand, *I. typographus* successfully colonized and produced offspring on cut bolts, which represent dying or stressed trees, of three exotic and one native spruce species although there were differences among tree species. Beetle attack density and emergence were higher in Norway and red spruce, relative to Lutz and Engelmann spruces. Further, tree species also influenced offspring development. Norway spruce yielded larger beetles than all three exotic species. The current study does not provide any evidence whether *I. typographus* can colonize and breed in live spruce trees in North America, however dying or stressed trees of all exotic spruce species tested are particularly vulnerable to *I. typographus* attack as long as the initial beetle population introduced is high around the infestation site.

DEFOLIATOR DYNAMICS AND CHANGING MANAGEMENT

Moderators: Lorraine Maclauchlan and Jennifer Burleigh
British Columbia Ministry of Forest and Range, British Columbia, Canada

This workshop was conducted as an open-forum with Lorraine and Jennifer "seeding" the audience with questions to stimulate discussion and debate. Lorraine opened the discussion with several slides showing the British Columbia situation with respect to defoliator outbreaks and management. Dr. Vince Nealis, Pacific Forestry Centre, Canadian Forest Service, also contributed a slide to the discussion. The slide depicted shifting western spruce budworm outbreaks in BC, from its mostly coastal location in the early 1900's to primarily inland outbreaks in more recent history. Vince's current research is focused on defining the phenology of the host in terms of insect development, emergence and feeding. BC currently has outbreak populations of the Douglas-fir tussock moth and western spruce budworm, often occurring in overlapping ranges. The tussock moth outbreak has just started whereas the budworm outbreak has been active in various parts of the southern interior of the province for over 20 years.

The five questions that were given to workshop participants were:

1) Discuss your thoughts on changes in historic defoliator distribution or range(?)
2) Defoliator impacts:

   How do you quantify?
   What are the impacts given changing social, ecological and economic values?
3) Management strategies and tactics (?)
4) Manage the insect? <u>or</u> manage the host?
5) Is direct control still pertinent in light of climate change? When? Where? Why?

Glenn Kohler presented an update on the status of defoliators in Washington. There are currently less than 300 acres of tussock moth outbreak but there are numerous issues with private lands. **Iral Ragenovich** is working on pheromone mating disruption using a flake formulation, which some land-owners are interested in trying. The largest challenge with tussock moth is the fragmentation of land ownership, which makes initiating control measures difficult.

Imre Otvos presented an update on his research on a unique strain of virus that will be tested on Douglas-fir tussock moth in 2009. This trial will isolate the influence of the introduced unique strain of virus *versus* the naturally occurring virus on tussock moth mortality in the area treated.

Discuss your thoughts on changes in historic defoliator distribution or range(?)

Many workshop participants noted that they have not observed any noticeable change in the distribution or range of the defoliators that they commonly work with. Alberta experienced a 25-year outbreak of eastern spruce budworm and treated areas for 9 of those years. They have recently noticed increased populations of western spruce budworm. During outbreak years in BC, there have been areas affected where the budworm has not historically been mapped (records going back to early 1900's). This does not imply that there have not always been endemic populations of the budworm. Current stand structure (higher density, more layering and a mix of age classes) as well as drought stress may have rendered these stands more susceptible to attack. Thinning seems to result in increased resilience to defoliation by budworm in Douglas-fir dominated ecosystems.

Defoliator impacts:
In the past, impacts have primarily been quantified by volume loss and thus impacts to commercial forestry. The current, and future, quantification may include accounting for "live trees" as part of a carbon credit system, the health of watersheds and other non-timber attributes. The group felt a need to question past, and current, assumptions – to account for the value of activities such as aerial spraying of *B.t.k.* and other insecticides.

Management strategies and tactics (?)
Manage the insect? <u>or</u> manage the host?
Is direct control still pertinent in light of climate change?

Silviculture treatments (thinning, spacing) seem to be effective and create more resilient stands. The social, legal and political arena is changing; thus must our management of forests and defoliators. Although there are good hazard and risk rating systems for budworm, and other defoliators, markets always seem to confound the good intentions of pest management strategies. In the US, the Forest Service uses the early warning trapping system, but has never been able to treat in the right year due to a very lengthy and laborious system to get permits in place for treatment. There is a need to know where high value lands are up-front and be ready to treat the areas in a timely and effective way.

RESEARCH UPDATES ON BARK AND AMBROSIA BEETLES

Moderators: Dan Miller, USDA Forest Service, Southern Research Station, Athens GA and Brytten Steed, USDA Forest Service, FHP Northern Region, Missoula MT.

We had about 30 participants with more than 95% participation in a round-table format. Both management and research interests were raised, with comments offered by a diverse group of participants. Attendees hailed from Canada and the United States with representation from national/state/provincial research and management agencies/branches/universities. As in 2008, the participants continue to encourage informal round-table format for future workshops as a welcomed alternative to presentation-based workshops.

As in 2008, the floor was open to discussions on all bark beetle species including all the popular species. This year, participants highlighted an extensive series of permanent sample plots for the western balsam bark beetle in British Columbia, concern about the prevalence and impact of the California fivespined Ips in Oregon, and the prevalence of attacks by flatheaded woodborers in Jeffrey and ponderosa pines. The use of ultrasonic sound frequencies was discussed by researchers from northern Arizona with a reality check on the potential use of high frequencies in the management of bark beetles. New this year were discussions on the abundance and diversity of exotic ambrosia beetles in the United States, and the need for identification of fungal symbionts associated with ambrosia beetles in general, a need arising in part from recent experiences with redbay ambrosia beetles in the South.

THE 2009 FUN RUN

The 2009 fun run was a great success, even with the threat of rain. Approximately 20 people ran around the Spokane Riverfront for 40 minutes. The run started from the hotel and went over several bridges from Riverfront Memorial Park to Gonzaga University and back to the hotel, with a stop to slide down the big red wagon slide in Riverfront Park. All runners returned safely to the hotel, most with smiles on their faces.

SILENT AUCTION AND WINE TASTING

POSTER SESSION

Authors	Title
Adams, Judy	Southern Pine Beetle Data Collection Through Web Portals *
Billings, Ron	Western Soapberry Borer
Coggins, Sam	Improvement of Forest Inventory Variable Estimates with Ancillary Data Supplied by Multi-source High-spatial Resolution Remotely Sensed Data
Dahl, Tracy	A Comparison of Resin Flow between Whitebark and Lodgepole Pine
Downing, Marla	Hazard Assessment Surfaces for *Orthotomicus erosus* *
Eckberg, Tom; Neal Kittelson; Jeff Fidgen; Carol Randall; Lee Pederson	Protection of High-Value Trees with Trunk Injected Systemic Insecticides *
Equihua-Martinez, Armando	*Dendroctonus mexicanus* and *Pinus cembroides* Association in Hidalgo, Mexico
Flowers, Robbie W.; Elizabeth A. Willhite	Distribution and Flight Periods of the California Fivespined Ips (*Ips paraconfusus)* in the Willamette Valley of Western Oregon *
Foote, Nathaniel; Seth Davis; Rich Hofstetter	Detecting the Role of Bacteria Associated with the Mycangium of the Western Pine Beetle *
Grant, Gary G.	Overview of *Dioryctria* Pheromones by Taxonomic Groups *
Graves, Andrew D.; Nancy E. Grulke; David M. Rizzo; Barbara Demmig-Adams; William W. Adams; Jeffrey D. Herrick; Steven J. Seybold	An Update on Defining a Mechanistic Link in Jeffrey Pine Among Stand Thinning, Drought, and Risk of Mortality from Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopkins *
Grosman, Donald M.; Stephen R. Clarke; William W. Upton	Two-year Protection of Loblolly Pine from Southern Pine Bark Beetles with Systemic Insecticide Injections *
Hadfield, Jim; Darci Carlson	Insects and Fungi in Fire-Killed Ponderosa Pines and Douglas-firs within the First Year of Tree Death *
Hancock, Grace A.; Richard W. Hofstetter; Danielle Reboletti; John C. Moser	Phoretic Mites and Lure Preferences by *Dendroctonus adjunctus* in Arizona *
Hicke, Jeff; Eric Pfeifer	Carbon Stocks and Fluxes of Trees Surviving Mountain Pine Beetle Outbreaks
Hofstetter, Richard	North American Bark Beetles - Short Course 2010 - Ecology, Taxomony, and Management *
Hofstetter, Richard; David Dunn; Deepa Pureswaran; Brian Sullivan	Acoustic Signals and Aggression Among Bark Beetles *
Howlett, Teri; Ingrid Aguayo; Bill Bauerle; Jose Negron; Lou Bjostad	Tree Physiology-Bark Beetle Interactions: Effects of Thinning and Environmental Stress *
Jack, David; John McLean; Gordon Weetman	Mountain Pine Beetle Progression and the Influence of Fertilizer *

* = poster available as a .pdf file at www.fsl.orst.edu/wfiwc/proc/2009posters/

POSTER SESSION, *continued*

Authors	Title
Kittelson, Neal; Andrew Mock	Optimization of Idaho's Gypsy Moth Program *
Kohler, Glenn; Jeff Moore	Bark and Wood Boring Beetle Activity Following Pacific Coast Windstorm *
Lerch, Andrew; Barbara Bentz; Darren Blackford; Kenneth Raffa	Evaluating and Monitoring Mountain Pine Beetle Infestation in Fire-Injured Ponderosa and Lodgepole Pine Stands *
McMillin, Joel	The Grand Canyon State Welcomes WFIWC 2010
Moser, John C.; Medea S. Burjanadze; Pavel Klimov; Lynn K. Carta	Phoretic Mite and Nematode Associates of the Spruce Bark Beetle, *Ips typographus (Coloptera: Scolytidae)* in Georgia *
Ott, Eric	Evolution and Plasticity in Ambrosia Beetle-Fungus Mutualisms
Progar, R.A.; D. Scott; C. Schmitt; L. Spiegel; B. Hostetler; B. Willhite; A. Eglitis; K. Chadwick; C. Mehmel; D. Goheen; S. Acker; L. Ganio	Assessing Post-fire Tree Survival in Oregon and Washington *
Progar, R.A.; J. Lundquist; A.R. Moldenke	Distribution of Arthropod Communities Along a Latitudinal Transect From Seward to Prudhoe Bay, Alaska *
Reid, Mary; Josee Methot	Bark Beetles Over the Edge *
Schwandt, John; Sandy Kegley; Dana Perkins; Ken Gibson; Holly Kearns	Whitebark Pine Stand Conditions after Mountain Pine Beetle Outbreaks *
Six, Diana L.	What Role does Phytopathogenicity Play in Bark Beetle-Fungal Symbioses?
Sprengel, Keith	Cooperative Aerial Insect and Disease Detection Survey Program - Pacific Northwest *
Sprengel, Keith; Julie Johnson; Bruce Hostetler; Kim Mellen-McLean; Beth Willhite	Estimating Snag Densities and Down Wood Using Aerial Survey Data *
Stark, Dan	The Response of Bark and Wood Infesting Beetles and Tree Pathogens to Fire and Fire-surrogate Treatments in a Mid-elevation Sierran Mixed-conifer Forest
Steed, Brytten; Holly S.J. Kearns; John C. Guyon II; James T. Hoffman	Aspen in Montana and Northern Idaho: Third Year of Monitoring Aspen Condition in the Northern and Intermountain Regions *
Waring, Kristen M.; Danielle M. Reboletti; Lauren A. Mork; Richard W. Hoffstetter; Ching-Hsun Huang; Amanda M. Garcia; Peter Z. Fule; T. Seth Davis	Modeling the Impacts of Two Bark Beetle Species under Warming Climate in the Southwest: Ecological and Economic Consequences *
Whitehouse, C.M.; W.B. Strong; M.L. Evenden	Multiple Mating and Seasonal Flight of *Dioryctria* spp. (Lepidoptera: Pyralidae) in B.C. Seed Orchards *

* = poster available as a .pdf file at www.fsl.orst.edu/wfiwc/proc/2009posters/

GROUP PHOTOGRAPHS

Group Photo 1:
Front Row (L to R): Bill Riel, Art Stock, Terry Rogers, Nancy Gillette, Jeff Webster, Mary Ellen Dix
Back Row (L to R): John Dale, Mary Reid, Don Alstad, Dan Miller, Skeeter Werner, Sunil Ranasinghe, Mike Maximchuk

Group Photo 2:
Front Row (L to R): Janice Hodge, Steve Seybold, Greg Smith, Darien Blackford, Ken Gibson, Bob Rabaglia
Back Row (L to R): Teri Howlett, Kathy Bleiker, Darek Czokajilo, Robb Bennett, Andy Eglitis, Steve Patterson, Dave Russell

Group Photo 3:
Front Row (L to R): Izzy Heller, Andrew Graves, Sheryl Costello, Bill Schaupp, Kathy Sheehan, Phil Aune
Back Row (L to R): Jim Corrigan, Robert Hodgkinson, Bill Jacobi, John Lundquist, Nadir Erbilgin, Caroline Whitehouse

Group Photo 4
Front Row (L to R): Babida Bains, Judy Adams, David Jack, Carl Jorgensen, Neal Kittelson, John McLean
Back Row (L to R): Sam Coggins, Jeremy Allison, Jennifer Burleigh, Tom Eckberg, Diana Six, Theresa Dahl

Group Photo 5
Front Row (L to R): Connie Mehmel, Bobbe Fitzgibbon, Dan Miller, Julie Brooks, Keith Sprengel, Imre Otvos
Back Row (L to R): Rob Cruz, Steve Clark, John Moser, Tom Coleman, Brian Sullivan, Karen Ripley, Steve Munson

Group Photo 6:
Front Row (L to R): Amy Carroll, Kristen Waring, Melissa Fischer, Ingrid Aguayo, Darci Carlson, Ladd Livingston
Back Row (L to R): Armando Equihua, Carlos Magallon, David Quiroz, Ken White, Lorraine Maclauchlan

Group Photo 7
Front Row (L to R): Bruce Hostetler, Ron Billings, Nathaniel Foote, Grace Hancock, Rich Hofstetter, Seth Davis
Back Row (L to R): Pat Ciesla, Fraser McKee, Joan Westfall, Bob Cain

Group Photo 8:
Front Row (L to R): Richy Harrod, Rick Kelsey, Ward Strong, Honey-Marie de la Giroday, Joel McMillin, Scott McLeod
Back Row (L to R): Bill Ciesla, Tim Ebata, Jeff Moore, Kishan Sambarayu, Rob Flowers

Group Photo 9:
Front Row (L to R): Alex Mangini, Don Owen, Liz Hebertson, John Schwandt, Beth Willhite, Sandy Kegley
Back Row (L to R): Bruce Thomson, Peter Rattray, Jim Heath, Bill Murray

Group Photo 10:
Front Row (L to R): Jeff Hicke, Von Helmuth, Mike Johnson, Glenn Kohler, Amy Gannon, Don Fowler
Back Row (L to R): Dan West, Jordan Koopmans

Group Photo 11:
Front Row (L to R): Ben Smith, Lisa Lunley, Cynthia Snyder, Tiegan Snyder
Back Row (L to R): Tim McConnell, Lee Pederson, Roger Burnside

Group Photo 12:
(L to R): Dan Stark, Dwight Scarbrough, Jerry Beatty, Dave Lance

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