PROCEEDINGS

THIRTY-SIXTH ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

BOULDER, COLORADO

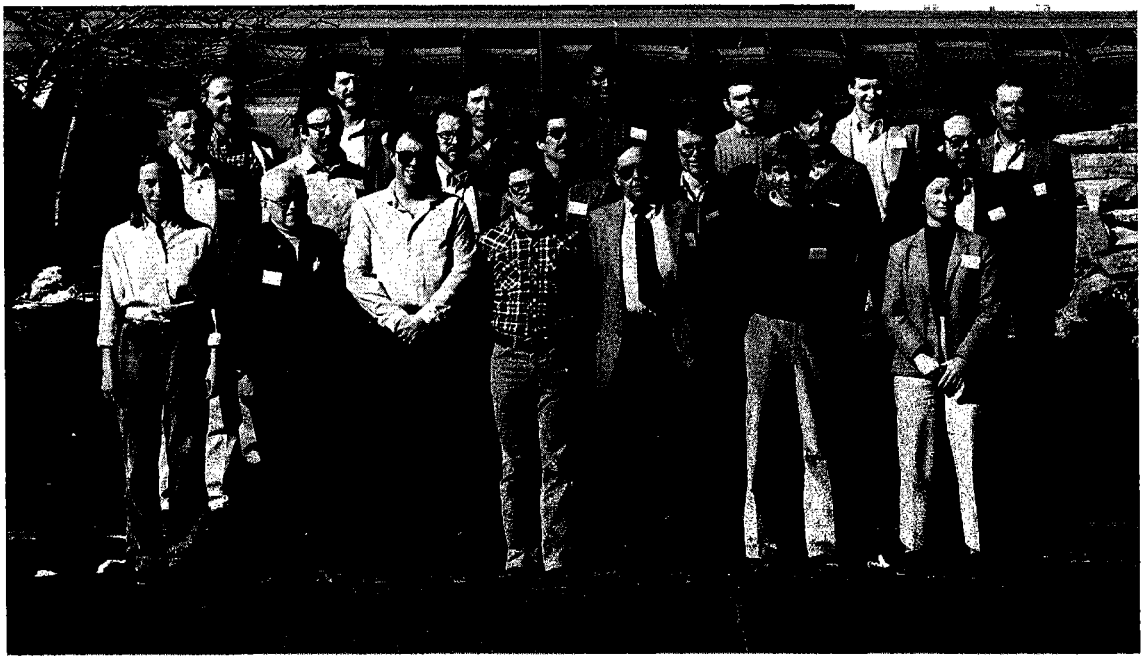
MARCH 4-7, 1985

Not for Citation
(For information of Conference Members Only)

Prepared and Printed at
Northern Forestry Centre
Canadian Forestry Service
Edmonton, Alberta

Front Row, L-R: Ann Keysor, Molly Sinnott, Leslie Chong, Peter Barth, Nancy Rappaport, Balazs Elody, John Hard, R.D. Averill. Middle Row: Dave Holland, Stephen Burke, Mitchel Miller, Sandy Gast, Sara Zimmer, Gary Hodges, Ken Zogas, Karen DeBord, Jim Robb. Back Row: Dave Schultz, Jerry Beatty, David Shaw, Pete Lorio, Staffan Lindgren, Peter Hall, Ed Holsten.

Front Row, L-R: John Pierce, John Schenk, Donn Cahill, Larry Stipe, Ann Lynch, Bob Celaya, Bernie Raimo, Iral Ragenovich. Middle Row: Ken Gibson, John McLean, Wes Nettleton, Jon Sweeney, Bill McCambridge, Ben Moody, Raymond C. Shearer, Jesus A. Cota, Bill White. Back Row: Marion Page, Chuck Richmond, Tony Smith, Bob Frye, Jim Michell, Mike Watner, Tom Swetnam, Dennis Hart, Dave Nielsen.



Front Row, L-R: Deirdre Haneman, Dick Jeffers, Steve Spaulding, Bob Sturtevant, John Laut, Matt Holmes, Karen Clancy. Middle Row: Chris Sanders, Ron Billings, Bob Bridges, Fred Stephen, Stig Larsson, Borys Tkaca, Skeeter Werner. Back Row: Dick Schmitz, Gene Lessard, Ken Lister, Curtis O'Neil, Ladd Livingston, Scott Salom, Dick Myhre.

Front Row, L-R: Tom Koerber, Jan Volney, Bob Scharpf, Debbie McCullough, Jeff Witcosky, Stephen A. Mata, J.M. Schmid. Middle Row: Steve Kohler, Craig Jones, Roy Beckwith, Marc Linit, Mary Ellen Dix, Robert Lavigne, Terry Rogers, Molly Stock. Back Row: Michael A. Marsden, Dave Leatherman, Phil Straub, Mark Harrell, Temple Bowen, Bill Ciesla, John Witter, Dave Johnson.

L-R: Roy Shepherd, George Harvey, John DeBenedictis, P.T. Dang, Dick Hunt

PROCEEDINGS

THIRTY-SIXTH ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

BOULDER, COLORADO
MARCH 4-7, 1985

Executive Committee (Thirty-Sixth WFIWC)

J. McLean, Vancouver, B.C.	Chairperson
R. Stark,	Immediate Past Chairperson
B. Moody, Edmonton, AB	Secretary-Treasurer
K. Sturgeon, McMinnville, OR	Councilor (1982)
P. Hall, Victoria, B.C.	Councilor (1983)
N. Crookston,	Councilor (1984)
D. Leatherman,	Program Co-chairperson
J. Schmid,	Program Co-chairperson
W. White,	Local arrangements co-chairperson
B. Raimo	Local arrangements co-chairperson

CONTENTS

* Summary not submitted

TECHNICAL PROGRAM

Thirty-sixth Annual Western Forest Insect Work Conference
Boulder, Colorado
March 4-7, 1985

Monday, March 4

3:00 p.m.	Registration
6:00 p.m.	Evening Mixer
8:00 p.m.	Executive Meeting

Tuesday, March 5

7:00 a.m.	Registration
8:15 a.m.	Initial Business Meeting
9:15 a.m.	Chairperson's Address - John McLean
10:15 a.m.	PANEL: Operational Use of Mountain Pine Beetle Pheromones MODERATOR: John Laut PANELISTS: Peter Hall Ken Gibson Ben Moody (for Bob Miyagawa)
11:50 a.m.	Lunch
1:30 p.m.	WORKSHOPS: 1. Root Diseases and Bark Beetles MODERATOR: Gene Lessard 2. Distributional Patterns of Forest Insects MODERATOR: Paul Opler 3. Current Status of Pesticide Usage MODERATOR: Jack Barry

4. Great Plains Entomology Programs
   MODERATOR: Mary Ellen Dix

5. WSBW Silvicultural Prescriptions
   MODERATOR: Terry Rogers

3:15 p.m.

WORKSHOPS:

1. Insect Impact on Esthetics
   MODERATOR: Terry Daniel

2. Integrating Silvicultural Prescriptions for Insects and Diseases
   MODERATOR: Jerome Beatty

3. Assessing Forest Growth Using Tree Ring
   MODERATOR: Tom Swetnam

4. Atomospheric Deposition / Insect and Disease Interrelationships
   MODERATOR: Bill Ciesla

5. Rocky Mountain Urban Forest Entomology
   MODERATOR: Steven Day

Wednesday, March 6

8:00 a.m.

WORKSHOPS:

1. Mountain Pine Beetle Dispersal
   MODERATOR: Dick Schmitz

2. High Country Project
   MODERATOR: Gary Hodges

3. Interrelationships Between Forest Fertilization and Defoliator Population
   MODERATOR: Boyd Wickman

4. Disease Carrying Arthropods of Western Forests
   MODERATOR: Gary Maupin

5. Mixed Conifer Growth and Yield Model
   MODERATOR: Todd Mowrer

10:15 a.m. PANEL: Aspen Management in Southern Rockie
MODERATOR: Jim Beavers
PANELISTS: Wayne Shepperd
Bob Frye
Jere Mossier
Reed Kelley

11:50 a.m. Lunch

1:00 p.m. Field Trips

Thursday, March 7

8:00 a.m. WORKSHOPS:

1. Taxonomic Status of Budworms
   MODERATOR: Robert Stevens

2. Will Trap Trees Reduce Spruce Beetle Populations?
   MODERATOR: Ken Gibson

3. Insect Impact on Seed Production
   MODERATOR: Ray Shearer

4. Genetics and the Interactions Between Trees and Their Parasites and Predators
   MODERATOR: Jeff Mitton

5. Can Pitchouts Recover?
   MODERATOR: Merril Kaufmann

10:15 a.m. WORKSHOPS:

1. Taxonomic Status of Budworms (cont'd)

2. Geographic Information System Demonstration
   MODERATOR: Bill White

3. Aerial Photography for Detecting and Assessing Forest Insect Problems
   MODERATOR: Dick Myhre

4. Insect - Dwarf Mistletoe Associations
   MODERATOR: Frank Hawksworth

5. Plantation Insect Problems
   MODERATOR: Thomas Koerber

11:50 a.m. Lunch

1:00 p.m. Final Business Meeting

2:00 p.m. Adjourn for the Year

THIRTY-SIXTH WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Executive Committee Meeting
Boulder, Colorado, March 4, 1985

Chairperson McLean called the meeting to order at 8:30 p.m.

Present were:

John McLean, Chairperson
Ben Moody, Secretary-Treasurer
Peter Hall, Councilor

Absent were councilors Kareen Sturgeon and Nick Crookston, Program Co-chairpersons Dave Leatherman and John Schmid and local arrangements Co-chairpersons Bill White and Bernie Raimo.

Minutes of the 1984 Executive Committee Meeting and the Treasurer's Report were read and approved. Businesses arising from the 1984 Final Business Meeting were discussed.

Bill White was to talk on local tours at the Initial Business Meeting. Requested that members be encouraged to sign a list if staying at the Hilton Harvest House Hotel, to obtain a reduction on the cost of Meeting Rooms.

Peter Hall of the Nominatons Committee was charged with finding a new councilor for the position held by Kareen Sturgeon.

A letter from Roy Shepherd was read, in which he named the Co-chairpersons for the 1986 Victoria, B.C. WFIWC Meeting as Gordon Miller and Peter Hall. Correspondence from Mal Furniss was read and discussed. It included a request for submission of information toward an Illustrated Guide of Idaho Bark Beetles; the University of Idaho Insect Museum to be named after Wm. F. Barr; and access of WFIWC Proceedings to Forestry Libraries. It was decided to ask for comments from members at the Initial Business Meeting.

Harry Yates letter on the history of Forest Entomology in North America was read and will be forwarded to Ron Stark, Chairman of the Historical Committee.

Mail ballot on the common name for Choristoneura occidentalis did not go out from the WFIWC Common Names Committee. Moderator of the Choristoneura Workshop was to bring a recommendation to the Final Business Meeting.

S. Werner was to cohort someone into the Ethical Practices Committee.

A list of retirements and upcoming professional meetings was made for announcement at the Final Business Meeting.

The meeting was adjourned at 9:30 p.m.

THIRTY-SIXTH WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Initial Business Meeting
Boulder, Colorado, March 5, 1985

Chairperson McLean called the meeting to order at 8:20 a.m. and welcomed members to Boulder, Colorado.

Minutes of the 1984 Final Business Meeting and the Treasurer's Report were read and approved.

Chairperson McLean read correspondence from Mal Furniss on the Field Guide to Idaho Bark Beetles; and a note about the University of Idaho Insect Museum being named in honor of Wm. F. Barr, a longtime WFIWC member and former head of the Dept. of Entomology. Members who may have collected bark beetles in Idaho are welcome to communicate their records, etc. for inclusion in the Guide. A proposal about deposition of proceedings to libraries resulted in members recommendations that a statement appear on the title page that the Poceedings are for WFIWC members information only and are non citable. There was a suggestion to members to ensure that a central depositing of proceedings is made within their institutions so that others might check on workshop proceedings etc. It was felt that it would be too onerous a task to start circulating copies to libraries.

Harry Yates III wrote soliciting comments and/or support of the WFIWC members in developing a joint Forest Entomology History Committee with other work conferences in the US. This request was to be fowarded to Ron Stark who is the Recording Secretary of WFIWC's Historical Committee, for action.

As there was no representative of the Common Names Committee present, Bob Stevens was asked to bring up the proposed common name change for the western spruce budworm, at the Choristoneuera Taxonomy Workshop.

Members were invited by Ron Billings to attend the Southern Forest Insect Work Conference, Asheville, NC, July 28-Aug. 1, 1985

Chairperson McLean announced the retirement of Ron Stark.

Chairperson McLean requested members to think about invitations for the 1987 meeting.

Local arrangements Co-chairperson, Bernie Raimo asked members staying at the Hilton Hotel to sign a list as the rates for rental of the Meeting Rooms depend on the number of persons registered at the hotel. Surplus coffee mugs were being sold at $3.50 US each.

The meeting was adjourned at 9:15 a.m.

TREASURER'S REPORT

Thirty-sixth Western Forest Insect Work Conference
Boulder, Colorado, March 4, 1985

Balance on hand March 8, 1984	(+)	$3,343.89
Expenses:		
Hotel deposit for 1986 WFIWC	(-)	$ 81.70
Income:		
Interest	(+)	$ 142.84
Balance on hand December 31, 1984	(+)	$3,405.03
Expenses:		
Commemorative coffee cups for 1985 WFIWC	(-)	$ 598.91
1984 Proceedings publication	(-)	$ 772.90
Postage and shipping	(-)	$ 186.80
Bank service charge	(-)	$ 2.00
Income:		
Interest	(+)	$ 30.19
Balance on hand March 4, 1985	(+)	$1,874.61

CHAIRMAN'S ADDRESS

WESTERN FOREST INSECT WORK CONFERENCE

Boulder, Colorado
March 5, 1985

The past year has seen many changes. One of the dominating and driving forces of a lot of Forest Entomology in the west has concluded - the CANUSA Spruce Budworms Programs: West. These West and East programs met together for a final wake in Bangor, Maine last September. The Conference itself was preceded by a most interesting tour to company operations including the St. Regis Company in Maine; into New Brunswick to see Forest Protection Ltd., J.D. Irving's extensive spruce plantations at Black Brook, and a provincial nursery; in Quebec we visited Riviere du Loup and saw the extensive set up that the Quebec Ministry of Energy and Resources has established to handle spray programs for the eastern spruce budworm. We visited the downtown Quebec laboratory where all samples, including foliage for egg masses, branches for overwintering L2, later branch samples for L3-L6 larvae, as well as defoliation indices are evaluated. The decision is made by Michele Auger at this point as to whether a spray should be executed.

We returned to Bangor via Scott Paper and Great Northern Paper Holdings in Maine - a most interesting six days. You can read a fuller account of this field trip by Janet Searcy in the last CANUSA Newsletter. The windup conference itself was an intensive presentation of information, including several poster sessions - a very interesting meeting where eastern and western programs could be contrasted.

With the end of CANUSA, Ron Stark has "retired" to Moscow, Idaho after ensuring that Martha Brooks had the three western "books" well underway. Two are apparently with the printers and the third is going through a final review. Jim Colbert and Russ Mitchell are now in other assignments while concluding CANUSA affairs. Nick Crookston is running a modelling workshop in April to train people to use the budworm models to help them in their continuing management analyses. There has been a very solid effort to interface the various disciplines here and hopefully this will lead to more informed decisions in western spruce budworm management.

Is the budworm issue now solved? Nobody really seems to think so but we are making progress. I would like to mention two continuing activities. Firstly, Mike Wagner tells me that the Rocky Mountain Forest and Range Experiment Station has established a study entitled "Mechanisms of resistance in Southwestern Conifers to western spruce budworm". It is good to know that an effort is continuing to further unravel many of the mysteries touched on during CANUSA and we wish Mike and his team well.

On a different track, Region 3 has established an IPM Working Group, including WFIWC members Stark, Bible and Fellin, to

> "Offer input, as part of a broad spectrum of informed opinion, into the early stages of pest control decision-making. The Working Group is responsible for monitoring pest control programs in the Southwest Region for their adherence to the IPM concept and to critique proposed pesticide-use programs for social, environmental and economic effects".

This working group was a direct result of litigation to limit spray programs in the Carson and Lincoln National Forests. The memo of understanding states that first of all

"The Forest Service will suspend for five years the use of aerial application of chemical pesticides on the Carson National Forest on all areas already sprayed since 1981 or within the currently defined infestation area. The Forest Service may use chemical pesticides outside the defined areas on new infestations upon the recommendation of the IPM working group".

The working group is charged with initiating, designing and evaluating an IPM demonstration area in accordance with a March 9, 1984 Memorandum of Understanding. The demonstration area shall be an entomological unit of the mixed-conifer zone, managed by the Forest Serive for multiple use, which is currently threatened with infestation of the western spruce budworm. The purpose of the demonstration area shall be to demonstrate on an operational scale the feasibility of IPM methodology for the management of the western spruce budworm".

It seems that there is indeed life after CANUSA.

While the budworm has been having its fair share of attention, another delinquent defoliator, the Douglas-fir Tussock Moth, has been the target of further research in Canada. Imre Otvos reports that the integrated pest management system for the Douglas-fir Tussock Moth has been developed - essentially the use of pheromones for detection of males; egg mass sampling methods; sequential sampling systems for larvae; and treatment strategies, primarily use of the NPV Virus. This has been a cooperative effort with the B.C. Forest Service.

What of the bark beetles - the biggest scourge of the mature and overmature forests of the west? You will not be surprised to hear they are alive and well. So healthy in fact that the lodgepole pine forests of the

Cariboo Region in British Columbia are thoroughly infested and future wood supplies in the area are seriously threatened.

However, all is not lost. There is a CANADA/U.S. Lodgepole Pine-Mountain Pine Beetle Program. The memorandum of understanding developed for this project by Dave Graham and Ross MacDonald was signed after the 1981 Fairmont Hot Springs Conference in B.C. The emphasis has not been for an accelerated program but rather for an assessment of current knowledge; to agree on the important biological facts. This has not been easy and many people are cross-checking procedures such as stand hazard rating.

WFIWC members, Hall and Safranyik, are active in Canada along with many co-operators in B.C. and Alberta. Other names such as Cole, Amman, Dolph and Mitchell are also spotted in hazard rating system evaluation. Mark McGregor has been a major contributor to Demonstration Area development in co-operation with other regional forest entomologists. Dick Schmitz and D.M. Cole are sampling and developing life tables for MPB. Other programs, including the uses of semiochemicals, will be discussed in panels and workshops at this conference. Let's hope the news is encouraging.

Bark beetles, especially the mountain pine beetle (MPB), give impetus to larger programs. Bob Averill tells me of the High Country IPM Project for MPB and dwarf mistletoe on more than 500,000 acres of lodgepole pine in the Summit, Grand and Eagle Counties of Colorado where recreation values are high. This project will be described in detail in a Workshop on Wednesday morning. Also supporting our theme of "integrating the disciplines is the Methods and Application Group program called IPIAS (Integrated Pest Management Impact System). This is a linked set of models, data bases and computer programs developed in the context of pest

management concerns. Although MPB on ponderosa pine was its major initial focus, the objectives of IPIAS are to provide managers with the most up to date information that they can have to develop effective management strategies. Needless to say, interaction of a geographic information system with a data base management system along with forest and socioeconomic production models give the manager powerful information tools. A demonstration for the Saratoga spittlebug will be given in a workshop on Thursday morning.

Biological control continues to be emphasized in several studies. Roger Ryan has been working steadily since 1971-1972 on long term plots to evaluate larch case bearer parasites. The last five years work has resulted in very detailed data for analysis of population dynamics.

Interesting news from Imre Otvos regarding the winter moth in Victoria is that the two introduced parasites, the wasp Agrypon flaveolatum and the fly Cyzenis albicans, look as if they are established. One disturbing feature is the occurrence of hyperparasitoids in the populations - it is being followed with much interest.

Forest companies in B.C. have taken a greater interest in maintaining the quality of the logs that they are harvesting from their old growth stands. It has been estimated that the coastal industry is losing more than $65 million/annum as a result of ambrosia beetle attacks on logs. Several mills have independently assessed degrade losses in their operation to be in the order of $2 million/annum. These are real money losses, lost profits and sometimes lost jobs.

The basic research by Chapman, Dyer, Kingham and Nijholt (PFRC) and Hec Richmond, when he consulted with the Council of Forest Industries of

B.C., showed that log inventory control and hot logging procedures would minimise these losses. Recent definition of much of the semiochemical ecology of Trypodendron, both in Europe and in B.C. has given us a very useful tool to demonstrate to the foresters and logging engineers where they have problem populations. Survey trapping and mass trapping of two of the ambrosia beetles, Trypodendron lineatin and Gnathotrichus sulcatus, are now services available from a commercial company, Phero Tech Inc., whom many of you already knew for their MPB lures.

Two additional points of information from Canada. Firstly, hopes are now running high that a new Federal/Provincial agreement may soon be signed between Ottawa and Victoria. This could result in $300 million for increased forest management - some of this may find its way to pest management activities.

Secondly, the B.C. Forest Service is hiring forest entomologists (3) and pathologists so that all regions in B.C. will have a full professional team of a pest management coordinator, a forest entomologist and a forest pathologist, that will enable detailed input into balanced management plans.

On a more personal level, those of you who attended the ESA Annual Meeting in San Antonio last December will know that John Borden, of Simon Fraser University, was awarded the J.E. Bussart Memorial Award for his outstanding contributions to the semiochemical research of ambrosia beetles and bark beetles including MPB. Another leading light of the WFIWC, Molly Stock, was awarded the Western Women's Career Excellence Award recently. Our congratulations to John and Molly for their outstanding individual

efforts. You will also note that Molly has published a useful text on Graduate Student Research - hopefully a flyer on the book is on display somewhere at the meeting. I had better read it as soon as my students do so I can know what to expect!

On the topic of textbooks, I hope you have all had an opportunity to read Coulson and Witter's excellent new text "Forest Entomology - Ecology and Management". It is easy to read with full up-to-date citations in each chapter - this book will be of special interst to all who teach forest entomology. You can check further with John Witter - he is with us today.

We have come a long way in even 10 years - I wonder what our founding members would think of all that has transpired in recent years? Equally important is the challenge that lies shead of all of us to integrate our knowledge into the forest systems in which we work. Our promising young graduate students have very powerful new procedures at their fingertips as they analyse their problems - just as important for them to truly understand the forest in which they are working. We are beginning to truly reach out to the forest manager and work with him.

I wish you many useful discussions, useful head clearing arguments perhaps, but don't forget the constructive synthesis. Good luck.

John A. McLean
March 14, 1985

PANEL: OPERATIONAL USE OF MOUNTAIN PINE BEETLE PHEROMONES
Moderator: John G. Laut
Panelists: Peter Hall, Ben Moody (for Bob Miyagawa), Ken Gibson

Direct control, implemented in appropriate areas, will reduce populations of mountain pine beetle (MPB) or slow their rate of expansion. This provides additional time to revise land management plans to impose more long-term solutions that will avoid or minimize future losses.

Direct control, whether by harvest, fell and burn, peeling, or chemical treatment must treat a very high proportion of the population in any target area to be effective. Aggregating pheromones should enhance the efficiency of direct control by concentrating the population into a smaller area and/or reducing survey time required to locate trees for treatment. Pheromones may also be useful in preventing or inhibiting dispersal of MPB from designated cutting units until the treatment can be completed.

The panel members presented pheromone use information from British Columbia (Hall), Alberta (Moody), and the northern Rocky Mountain region of the U. S. (Gibson). Results in general were similar (although in 1984 Alberta populations apparently declined) and encouraging. B. C. considers it to be an operational tool.

There was unanimity in stressing that pheromones are <u>not</u> population reduction treatments in themselves. Their use is only as an adjunct to direct control, and appears to be feasible, practical and useful.

ROOT DISEASES AND BARK BEETLES
Moderator: Gene Lessard
Participants: Dave Johnson, Borys Tkacz

Three questions were posed: Where are we? Where are we going? How do we get there? First, where are we? A substantial amount of research has resulted in the identification of a number of associations between root diseases and bark beetles:

1. Bark beetles are passive vectors of root disease fungi.
2. Bark beetles are primary and secondary agents in the death of root diseased trees.
3. Bark beetles appear to be attracted to root diseased trees.
4. Root diseased trees serve as foci for the development of bark beetle populations and maybe epidemics.
5. Root diseases cause blowdown and are indirectly associated with beetle infestation.

However, associations are not correlations. Current research indicates beetles respond to ethanol and alpha-pinene both independently and in combination. These chemicals can be produced in moisture stressed and/or root diseased trees. There is some indication that resins produced during resinosis contain both ethanol and alpha-pinene; that infected roots placed in traps are more attractive to beetles than uninfected roots; and that landing rates of beetles are not significantly different between infected and uninfected trees but, initiation of attack by beetles (boring in and establishing egg galleries) is significantly greater for infected trees.

Where are we going? Work needs to continue to establish correlations between root disease and beetles. However, for this line of research to be applicable to managers, hazard rating systems need to be developed that have reliable predictive value. These systems should be based on site and stand conditions such as: soil and vegetation types, stand structure and history, presence of other diseases..... In addition, research should emphasize critical timing of silvicultural treatments in response to intensity of root disease infection and beetle infestation.

How do we get there? Continued integration of the disciplines of entomology, pathology and silviculture with emphasis on common goals will net greater benefits in the future.

WORKSHOP: DISTRIBUTIONAL PATTERNS OF FOREST INSECTS
Moderator: Paul Opler

Moderator Paul Opler first presented published evidence on the application of the Theory of Island Biogeography (MacArthur and Wilson, 1967) to the species richness and life history characteristics of forest insects. The second topic revolved around the need for detailed survey and mapping of North American forest insects, employing a uniform method such as that adopted by the British and Europeans with the Universal Transverse Mercator grid (UTM).

Species richness (species number) of phytophagous insects increases as the geographic area occupied by their host increases. Opler (1974) demonstrated the species-area relationship for oak-feeding lepidopterous leaf-miners in California, while Powell and Miller (1978) showed the same correspondence for numbers of pine tip moth (Rhyacionia) species and geographic range of different pines.

Another relationship is that the number of insect species on individual host trees is a combined function of tree size (analogous to island size) and number of species found on a host throughout it range (regional richness-analogous to species richness of continental source area). This has been demonstrated by Cornell (1984) for cynipid gall wasps (Cynipinae) on California oaks (Quercus). Unpublished data (Opler) confirms this for leaf-mining insects on chestnuts and chinquapins (Castanea).

These relationships allow one to predict the changes in species richness of forest insect pests in response to different forest management practices. For example, when the range of a conifer is increased greatly by the establishment of plantations or by its introduction into new areas, one can expect that new pests from related hosts will 'colonize' the new introduction.

The use of the Universal Transverse Mercator grid (UTM) in Britain and Europe (Heath and Perring, 1975; Heath and Scott, 1977) for the survey, atlasing, and assessment of insects was described.

REFERENCES CITED

Cornell, H.V. 1984. Geographic texture of herbivore richness patterns on host plants. Bulletin of the Entomological Society of America 30(2):6-15.

Heath, J. and F. Perring. 1975. Biological recording in Europe. Endeavor 34(123):103-108.

Heath, J. and D. Scott. 1977. Biological Records Centre, instructions for recorders. Natural Environment Research Council. Biological Records Centre; Abbots Ripton, U.K., 28pp.

MacArthur, R.H. and E.O. Wilson. 1967. Theory of Island Biogeography. Princeton University Press. 203pp.

Opler, P.A. 1974. Oaks as evolutionary islands for leaf-mining insects. American Scientist 62(1):67-73.

Powell, J.A. and W.E. Miller. 1978. Nearctic pine tip moths of the genus Rhyacionia: biosystematic review (Lepidoptera: Tortricidae, Olethreutinae). Agriculture Handbook No. 514, Forest Service, U.S. Department of Agriculture.

WORKSHOP: CURRENT STATUS OF PESTICIDE USAGE
Moderator: Jack Barry
Participants: Phil Grau, Temple Bowen, Dave Overhulser, Ken Lewis

Highlights of discussions on USDA Forest Service (FS) use of pesticides are as follows:

- Comparative annual pesticide use in million pounds of active ingredient.

	Agriculture	Home	USDA Forest Service
Insecticides & Fungicides	233	40	.3
Herbicides	445	25	.3
Animal and Other	55	0.1	.2

- Insecticides use national forest system (NFS) land, 1974-1984. 230,000 A. treated or 1/10 of 1% of NFS lands treated.

- Pesticide use on NFS lands 1980-1984.

Insecticides and Fungicides	43%
Herbicides	40%
Animal Control	17%

- Pesticides applied by air.

Insecticides	90%
Herbicides	25%

- Pesticides applied to NFS lands, 1984.

	Total Acres Treated	Aerially Treated
Herbicides	141,928	2,090
Insecticides	191,290	176,849

Carbaryl and Mexacarbate. These materials are registered for some defoliators. They are effective materials and provide a reliable alternative, along with other materials, to biological and cultural control.

Bacillus thuringiensis. There is increased use of B.t. to control gypsy moth, and both the eastern and western spruce budworm. Newer formulations are being applied at 12 and 16 BIU per acre at application rates less than 1 gallon per acre. Undiluted tank mixes have provided good results in the East. FS plans to pilot test undiluted tank mixes in the West during 1985. The FS has not been able to develop and maintain application technology for the new formulations of B.t. as producers are changing formulations faster than FS can conduct adequate field testing. Besides the two primary producers of B.t. - Zoecon and Abbott, other producers may be competing for the forestry market.

Seed Orchards. Guthion^{R} and Pydrin^{R} are the two primary insecticides used to control seed and cone insects. Both are effective. Serious incidents of scale have resulted from use of Pydrin in southern pine orchards. This problem is under investigation.

WORKSHOP: GREAT PLAINS ENTOMOLOGY PROGRAMS
Moderator: Mary Ellen Dix
Participants: Mark Harrell, Robert Lavigne, Max MacFaden, Ron Billings, Dick Jeffers

Some of the more serious insects of trees in the Great Plains were noted, and current research on and the management of these insects were discussed. The discussion centered on entomology programs in the northern, western, and central Great Plains and how the unique environment of the Great Plains affects these insects.

Robert Lavigne discussed his recent survey of insects and mites in Wyoming shelterbelts. A wide variety of insect pests was found in these shelterbelts; the most damaging were Malacosoma disstria Hubner, Nymphalis antiopa (L.), Chrysomela scripta F., and Scolytus multistriatus Marsham. These insects attack one or more of the three most commonly planted trees--cottonwood, Siberian elm, and willow. Cottonwood had the largest variety of insect pests.

Mark Harrell has identified two phloem-boring insects, Dioryctria ponderosae Dyar and D. tumicolella Mutuura, Munroe and Ross, in central Nebraska. These insects previously were identified as D. zimmermani (Grote). In Nebraska, the life cycles of D. tumicolella and D. ponderosae are 12 months and 14 to 24 months in length, respectively. Susceptiblility to infestation was high for ponderosa pine, intermediate for Austrian and Scotch pines, and low for jack pine. Trees growing on dry sites were more heavily damaged by these insects than trees growing on moist sites.

Mary Ellen Dix described her evaluation of the feeding preferences of Paleacrita vernata (Peck)on Siberian elm from the northern Great Plains. Larvae showed reduced feeding preference for approximately 40 of 160 sources of Siberian elm selected for resistance to P. vernata, for superior morphological characteristics, or for resistance to canker pathogens. Techniques used in windbreaks to evaluate the attractant preference of Petrova metallica (Busck), a tip miner of ponderosa pine in the northern and central Great Plains, also were discussed.

In summary, many insects damage trees in the Great Plains. The impact of different species varies with site and condition of the trees. Research on and management of several of the more serious tree pests in portions of the northern, western and southern Great Plains are limited by lack of forest entomologists and state funding.

Workshop: WSBW SILVICULTURAL DEMONSTRATION AREAS IN NEW MEXICO
Moderator: T.J. Rogers

At least 35 people of varying backgrounds and job responsibilities attended this workshop. An agenda was not pre-selected. Informal, open exchange was our objective.

For background we began this workshop by briefly highlighting selected past Western Forest Insect Work Conferences that delt with the silvicultural management of WSBW outbreaks. Although there have been numerous workshops conducted on various aspects of the WSBW and its management, workshops highlighted were those at which the moderator attended, namely those held in Missoula, Montana in 1982 and Eugene, Oregon in 1983. The purpose of this overview was to establish some common rederence points for those attending this workshop.

Highlighted from the 1982 conference was the fact that there was much discussion centering on whether-or-not there were specific silvicultural prescriptions available for managing budworm outbreaks in mixed conifer stands in the west. Whether-or-not this question was ever resolved is still open to question. However, there was general agreement that any silvicultural strategy that promoted and increased stand vigor, regulated stocking and favored nonhost species where appropriate would favor management of the WSBW. Emphasized at several workshops conducted in 1982 was that silvicultural prescriptions implemented in budworm susceptible/vulnerable stands must be specifically tailored to the site and must also consider numerous items besides the budworm such as ecological habitat type, forest cover, slope, aspect, elevation and social and economical concerns. In addition, optimal species diversity should be prescribed for, with budworm nonhost species favored where applicable. Many of the same points were emphasized and dicussed at this workshop. Highlighted from the Eugene meetings was the fact that regardless of the silvicultural strategies implemented to reduce budworm stand vulnerability, these silvicultural strategies will not prevent outbreaks of the WSBW from occurring in the future. However, the frequency, duration, and overall impacts of future outbreaks may be significantly reduced.

The remainder of the workshop primarily centered on the WSBW outbreak in northern New Mexico. Topics discussed included a brief description of the history of the budworm in New Mexico, stand conditions (susceptibility/vunerability), past logging practices and their effects on existing stands, and the effects of several silvicultural systems established on the Carson National Forest in northern New Mexico as a long-term demonstration area in 1981. Silvicultural systems demonstrated include:

1. Shelterwood with planting
2. Shelterwood protecting advanced regeneration
3. Overstory removal
4. Clearcut with planting
5. Control

Briefly discussed were the effects of these silvicultural strategies on outbreak WSBW population levels and defoliation. Early results obtained show that these silicultural strategies provide little relief from the current outbreak. However, in the long-term it may be that overall damages such as growth loss, top-killing, and tree mortality will be significantly less in these silviculturally treated areas when compared to unmanaged stands (control).

WORKSHOP: ASSESSING INSECT IMPACTS ON FOREST GROWTH USING TREE RINGS
Moderator: Tom Swetnam
Participants: Art Raske, Tom Koerber, Mike Wagner, Jan Volney, Bob Scharpf, Jerry Buk, Mike Marsden, Pete Lorio, Stig Larson, Bob Frye, Donn Cahill, Larry Stipe, Sara Zimmer, Dave Leatherman, Ken Zogas, John Hard

Following the introduction of all participants the moderator presented an overview of dendrochronology methods as they can be applied to assessments of growth losses in trees due to insect attack. Crossdating was emphasized as a fundamental procedure in order to identify years when annual rings are absent in tree ring samples. The concepts of standardization, filtering, and comparison of host and non-host tree-ring chronologies to identify insect attack effects were discussed and illustrated with handouts.

Participation and discussion was very active with numerous comments and observations by individuals with considerable personal experience in the study of insect effects on tree growth:

- Mike Wagner related his experience in measuring radial growth of pandora moth defoliated ponderosa pine trees from Northern Arizona. He found that in 25 of 30 sample trees no growth rings were present during one or more years of the current outbreak period. Art Raske indicated that absent rings were not uncommon in defoliated balsam fir trees from eastern Canada, especially in the upper crowns.

- Tom Koerber shared his observations of growth patterns in damaged lodgepole pine. He has noted that many trees display an increased growth rate following insect attacks. Tom Swetnam also indicated that he has observed this effect in Douglas-fir trees following budworm outbreaks. There was some consensus of opinion that this effect is probably related to changes in canopy status of the surviving trees, and possibly a fertilization effect through deposition of insect frass on the forest floor.

- Art Raske emphasized the need for stem analysis procedures involving many samples along the entire boles of defoliated trees because of observed differences in radial and volume growth loss between the lower and upper boles of balsam fir trees. There was some discussion of the limitations of stem analysis and radial growth measurements as assessments of tree growth. Radial growth measurements from the lower bole may underestimate growth loss throughout the stem, while stem analysis procedures may require destructive sampling and a smaller tree sample size because of the greater time and data requirements. It was suggested that at least some trees from a growth assessment project be intensively studied using stem analysis procedures, and if possible, a site and species specific functional relationship be developed between radial growth at the base of the tree and at other locations along the stem.

- Bob Scharpf reported loss of current years foliage of white fir in California by a needle cast fungus with very little or no apparent radial growth loss, yet the local Christmas tree market was severely impacted.

- Mike Marsden and Donn Cahill discussed aspects of their tree-ring and growth assessment work in Idaho. Prognosis models have been applied to estimate growth losses, and there was some emphasis in the discussion for a need to utilize direct tree-ring measurements for calibration and verification of the growth and yield models.

WORKSHOP: ATMOSPHERIC DEPOSITION/INSECT AND DISEASE INTERRELATIONSHIPS
Moderator: Bill Ciesla
Participants: Approximtely 25 people participated, many of whom contributed to the workshop discussions.

Atmospheric deposition is the term currently used to describe deposits of gaseous, liquid, and solid pollutants from man caused or natural sources. This has received increased concern by the scientific community and the general public. This concern is centered around the recombination of gaseous pollutants with atmospheric moisture resulting in precipitation of a lower than normal PH. Rain water is naturally slightly acid with a PH of about 5.65. Certain areas of the eastern US have reported rain water with a PH as low as 4.2. Episodes of fog, mist or rime frost have been reported with PH's as low as 3.0.

Atmospheric deposition, in its various forms, has been suspected as the causal agent responsible for the apparent disruption of both acquatic and terrestrial ecosystems. This includes cases of sterilization of lakes and ponds and widespread forest decline both in North America and Europe. There are are a number of possible atmospheric deposition/ insect and disease inter-relationships. These include:

1. Atmospheric deposition damage can predispose trees to insect or disease. A number of cases of insect problems believed to be associated with atmospheric deposition are known. Certain scale insects are known to be associated with high levels of dust on conifer foliage. Infestations of these insects are often associated with logging roads. Several outbreaks of Geometrid defoliators have been associated with industrial smoke plumes in B.C. A long term outbreak of fruit tree leaf roller in the Lake Arrowhead region of southern CA may be associated with air pollution from the Los Angeles Basin.

2. Insect and disease damage can be confused with suspected atmospheric deposition damage. During the past year, Engelmann spruce near Gothic, CO was diagnosed as having symptoms of acid rain damage. This received a great deal of publicity in local news media. Follow-up evaluations revealed that the trees were infected with root pathogens and contained bark beetle infestations. There was no evidence of damage due to atmospheric deposition of pollutants. Similarly, mortality of Fraser fir in NC and TN caused by the balsam woolly aphid has recently been confused with acid rain damage. Some scientists have hypothesized that aphid mortality is present because trees are stressed by high pollutant levels. Dieback, often associated with successive insect defoliation, has been linked to atmospheric deposition.

3. Background damage levels could mask damage caused by atmospheric deposition of pollutants. Many scientists believe that high elevation forests have the greatest potential for damage by pollutants. These areas tend to have shallow soils with a low buffering capacity. In addition, there is evidence that atmospheric transport patterns result in higher deposits of pollutants on high mountain peaks. These sites generally contain forests with high background levels of top kill, tree mortality, branch dieback, and other mechanical injury. These levels of damage could mask early foliar symptoms caused by pollutants, making it more difficult to recognize damage if and when it occurs.

TITLE: ROCKY MOUNTAIN URBAN FOREST ENTOMOLOGY

Biology and control of insects in the urban environment poses a whole new and challenging set of problems, questions and answers, vis a vis in the forest environment. The concept of Integrated Pest Management (IPM) in the urban horticultural/arboricultural context is much different than the agricultural context. The urban environment is much more complex, and has many more artificial elements to affect the "balance of nature".

Progressive arborists and others entrusted with the professional care of landscape plants are continually striving to find ways of controlling insect pests without the heavy, broadcast use of pesticides. Here are a few examples of the types of programs which are in use today, at least in the Denver-Boulder metro area.

(1) Southwestern pine tip moth (*Rhyacionia neomexicana*)

Monitoring of this insect with a pheromone bait provided by Albany International begins around mid-April. Adults are usually in flight towards the later part of April and well into May. Previous to monitoring for this insect, spray applications were made to all Austrian, Ponderosa, and Mugho pines in landscape plantings. Control was erratic and expensive. Now, due to careful monitoring and greater understanding of the insect, spray applications are done on a timely basis, and only on relatively small pines. Fortunately, this insect is relatively easy to control at this point. In many cases, homeowners are informed that this insect usually doesn't do permanent, disfiguring injury and a spray treatment may not even be necessary.

(2) Ash/lilac borer

This insect is also monitored with a clear-wing moth bait. Control can be achieved easily with a one-time spray application. It used to be that two, blindly timed spray applications may control this insect. After an infestation is controlled, the problem is dealt with from a tree vigor enhancement standpoint, rather than continued spray applications. Fertilization, watering, relieving compaction, etc. are incorporated into a comprehensive plant health program.

The use of additional and alternative control methods can apply to almost every insect pest one comes across in our area. For example: pheromone traps; biophenometers, other degree-day calculation techniques; spot pesticide treatments; fertilization; soil injection of pesticide; phenology models; field spot checks; and others greatly help us to understand how to adequately control certain pests with a minimum use of pesticides sprayed into the environment.

The use of pyrethroids has seen tremendous growth in our area. In fact, it is probable that 40-50% of all spray applications use a pyrethroid. Many of the old standby petrochemicals are being dropped and substituted with

pyrethroids and biologicals, due mainly to adverse toxicological properties, public relations problems, phytotoxicity, and in some cases

resistance problems.

Insect control in the urban environment is an absolute necessity in many cases. The techniques and materials available to professionals have, and will continue to change rapidly. Recognition and correction of cultural problems will receive more attention as methods of pest control, as will a comprehensive, year by year approach to plant health and landscape management.

As the public becomes more informed of what holistic plant health management means, they will demand more complete and environmentally sound methods of controlling pests and managing landscapes. This will present a unique set of challenges to professional landscape plant managers and will create a need for qualified pest control technicians, marketing and advertising personnel, community relations personnel, and other similar professional positions.

Submitted by Steven J. Day

PANEL: WESTERN FOREST INSECT WORK CONFERENCE: THE HIGH COUNTRY PROJECT
Moderator: Gary V. Hodges, Project Coordinator
Panelists: Terry Beeson, High Country Operations Manager
Phyllis Conway, Summit County Administrator
John Windsor, Timber & Fire Management Staff Oficer,
Arapaho/Roosevelt National Forest

This panel had the objective of introducing the participants to the project's objectives, organization and results in dealing with epidemic populations of Mountain Pine Beetle. Our first panelist, Terry Beeson, introduced the project and talked about his experiences as the Operations Manager. Terry's discussion was followed by a video tape: "Working Toward a Healthy Forest", which was produced to demonstrate the project's goals as an interagency community cooperative forest management project.

Phyllis Conway, Summit County Administrator, then gave her impressions of the community advantages sustained by the Project.

John Windsor, Timber & Fire Management Staff Officer for the Arapaho and Roosevelt National Forest, briefed the group on how the National Forests participate in the project and related successes of similar projects in which he was involved.

In summary, our panel related that the High Country Project is a partnership of state, local and federal managers working together with private landowners to combat the effects of epidemic populations of Mountain Pine Beetle. The project was initiated in Summit and Upper Eagle counties in 1982, and was later expanded to include Grand county in 1984.

Early in the project, emphasis was placed on direct control strategies or treating the stands of timber already infested by the insect. Direct control techniques have largely included: felling, bunching and chemically treating the infested material, or removing the infested logs to designated sites for processing to lumber or chips.

The stated role of the High Country participants is to coordinate the efforts of government and private landowners to place lodgepole pine under management with a goal of minimizing the effects of insects and disease so that short and long term resource objectives can be met in the future. Our role as stated, recognizes that application of proven management practices can modify the forest cycle of regeneration, growth, maturity and mortality to maintain a level of growth and forest health which reduces the potential of catastrophic mortality. Accordingly, the executive council level of the High Country organization has established the following goals for the project:

1. Minimize adverse impacts of MPB by establishing vigorous insect and disease resistant forests.

2. Maintain, or improve, scenic and recreation qualities.

3. Maintain, or improve, wildlife and fisheries habitat.

4. Reduce wildfire hazards.

5. Salvage infested and dead lodgepole pine.

Given these goals, our present course of direction on the management of the Mountain Pine Beetle and its host is based on the following assumptions:

1. MPB can be managed to minimize its adverse impacts on the various forest resources.

2. Removal of infested trees through timber sales is the preferred direct control method. Direct control with chemicals is a viable tactic in areals of relatively high value.

3. Prevention of MPB attack with chemicals is feasible on individual high value trees.

4. Prevention of MPB infestation of stands through silvicultural manipulation is feasible where values at risk support that decision.

5. All lodgepole pine stands, regardless of ownership can be stratified according to risk and value, thus allowing treatment priorities to be set and to guide choice of suitable tactics.

Given these assumptions, harvest and sale (salvage) of currently infested trees is the preferred method of direct control. Chemical control (Lindane) may also be needed when infested trees cannot be moved before beetle emergence and flight.

There appear to be net benefits from continuing with chemical prevention control efforts (Sevin) in those higher value areas where the beetle is present.

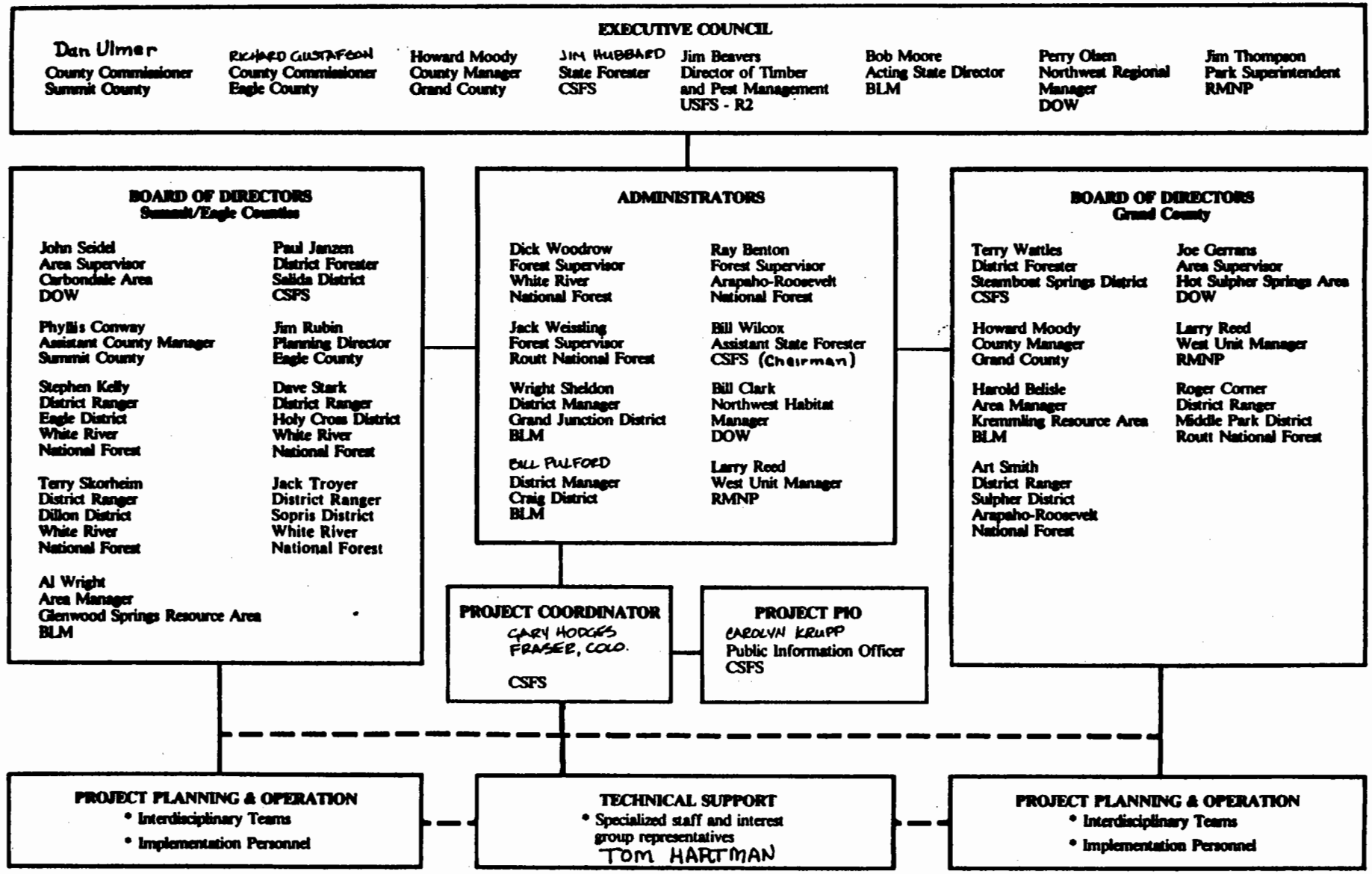
Under current conditions the greatest benefit appears to be from thinning in those areas where beetles are not yet present, or at relatively low levels.

Recognizing that funds for this approach are limited, we are now formulating a process whereby we can classify lands so that we may prioritize and schedule appropriate treatments.

This effort will result in a report which will schedule specific management activities on high priority areas.

An organization chart has been included as a part of this summary, for your use.

HIGH COUNTRY PROJECT
Organization Chart



CSFS — Colorado State Forest Service USFS — United States Forest Service BLM — Bureau of Land Management RMNP — Rocky Mountain National Park DOW — Division of Wildlife

WORKSHOP: INTERRELATIONS BETWEEN FOREST FERTILIZATION AND DEFOLIATOR POPULATIONS
Moderator: Boyd Wickman
Participants: Approximately 40 attendees

Four questions were posed at the beginning of the workshop to help guide discussion.

1) What are the effects of fertilization on tree vigor: who benefits the most, the insect or the tree?
2) Does fertilization influence the production of defensive chemicals in foliage?
3) What are the effects of fertilization on natural enemies of herbivores.
4) How does fertilization effect the population dynamics of defoliators?

Dr. Stig Larsson, a guest from the Swedish University of Agriculture Sciences, Uppsala, got us started by describing his research on the effects of fertilization and pine sawfly outbreaks in Sweden. He also described some new research on the production of defensive chemicals in willow after fertilization. This started a lively discussion on the topics listed with particular contributions by Elizabeth Blake, Mike Wagner, George Harvey, Skeeter Werner, Pete Lorio, Karen Clancey, Roy Beckwith, and others.

My interpretation of the discussions were that we know something about item #1. We are now learning, through new research, about item #2. We know little or nothing about items #3 and #4. Graduate students here is your chance!

WORKSHOP: DISEASE CARRYING ARTHROPODS OF WESTERN FORESTS
Moderator: Gary Maupin
Participants: Four attendees

The life history and habits of the more important western ticks were discussed in relation to human activity in National Forests and Parks. Specific diseases carried by each tick, their symptoms and effects on human health were also discussed. The importance of other hosts, specifically small mammals, in maintaining the disease carrying arthropods was stressed. Several case histories for "outbreaks" of particular diseases in specific locations were related. The attendees related personal experiences and observations of ticks encountered during their field activities.

WORKSHOP: MODELING GROWTH AND YIELD IN SOUTHWESTERN MIXED CONIFERS
Moderator: Todd Mowrer
Participants: Approximately 15 people in attendance

The workshop topic was divided into two parts: a general growth and yield modeling discussion and specific application to the problems of modeling southwestern mixed conifers. The three types of growth and yield modeling approaches were outlined first: individual-tree, distance-dependent; individual-tree, distance-independent; and stand average models. Intermediate to the last two approaches were diameter distribution and diameter class approaches. Common methods of estimation within models included least squares linear and non-linear regression and individual and systems of differential and difference equations. This stimulated discussion on the philosophical and theoretical differences between empirical and analytical modelers. Empirical modelers concentrate upon obtaining the best fit to their data, letting the data determine the functional relationship, subject to valid biological principles. This approach may sacrifice broad applicability in favor of greater accuracy for a narrow range of conditions. Analytical modelers, however, first determine a biologically based function hoping to obtain a more widely applicable relationship, though possibly sacrificing the best fit. Validation methods discussed included independent permanent growth plots, data splitting, Monte Carlo simulation, and variance estimation equations.

The uneven-aged, mixed species stand composition encountered in southwestern mixed conifers helped to determine which modeling approach would provide the necessary level of information with the greatest accuracy. The diameter class model used for southwestern mixed conifers was introduced in this context. Characteristics of the calibration data were presented. Driving variables for the diameter class model were discussed with respect to overall model operation. Functional relationships were examined for diameter class growth, average diameter class height, and diameter class mortality estimation. The use of dendrochronology to more accurately reflect mortality in temporary growth plots was suggested by an attendee. The problems encountered in estimation of dwarf mistletoe intensification were enumerated. Discussion ensued on both these subjects. The interrelation of the growth projection functions was outlined for the overall modeling sequence. Input data necessary to initialize the model, cutting options, and model output by diameter class, species, and stand were enumerated. The presentation ended with a discussion of how to choose an appropriate growth and yield model and words of caution to their application.

ASPEN MANAGEMENT FROM A DISTRICT FORESTER'S VIEWPOINT
PANEL: ASPEN MANAGEMENT IN SOUTHERN ROCKIES
WESTERN FOREST INSECT WORK CONFERENCE
MARCH 6, 1985
BOULDER, COLORADO

Bob Frye

Aspen is many things to many people and disciplines. For Aspen is truly a multiple use resource. Aspen stands produce an abundance of wood, water, forage, wildlife and recreation. No other vegetation type in the interior west does as well in total net production of these 5 resources nor does any other vegetation type in Colorado receive the press or public attention. To many recreationists all conifers are pines but an aspen is an aspen. Aspen has no identity crisis in this part of the country.

Because of aspen's multiple use values people from many disciplines consider themselves experts and rightfully so. This has resulted in much of the research being done by disciplines other than silviculturists. Personally I have learned much about aspen silviculture by spending time in the field with Tommy Hinds, a pathologist, and Gordon Gullion, a Lakes States wildlife biologist.

A survey of forest managers in the 1970's on the relative value of aspen resulted in the following ranking. Wildlife was first, followed by aesthetics, recreation, water, livestock forage and wood products last.

To the Wildlife Biologist, aspen is an important habitat for numerous species of wildlife. Over 60 wildlife species on the Pagosa District utilize aspen stands for both feeding and reproduction. Of all the tree species in the Rocky Mountains, aspen is the number one preferred big game browse. Studies have shown a significant relationship between hunter success in an area and the acreage of aspen type.

For both the range conservationist and wildlife biologist aspen stands can be the most productive forage and forb producers. Aspen stands typically produce 14 times as much grass and four times the yield of forbes when compared to mixed conifers. As a result the aspen type is considered essentially a range rather than a wood producing forest by those oriented towards livestock production.

Aspen provides recreation in many forms. We are all aware of its autumn colors but the winter recreationist chooses aspen over conifer areas for cross-country skiing and snowmobiling. Recreationists also enjoy campgrounds in aspen but experience has shown that concentrations of people in developed campgrounds will destroy an aspen stand in just a few years.

To the hydrologist aspen is an excellent site for water yield and watershed protection. A typical Colorado aspen stand yields an acre foot of water annually from each acre of an aspen covered watershed. The quality of stream flow is high because virtually all of it

percolates through porous soil and enters streams as interflow. Aspen also has more water available for run-off than conifers.

As a wood producer, aspen can produce on the best sites as much as 220 bf/ac/yr net growth over a 100 year rotation. However, as a sawlog it leaves much to be desired. It is generally highly defective in terms of both visible and hidden rot and extremely crooked. Almost anything that can be wrong with a log can occur in aspen.

Traditionally aspen has been considered by some foresters as a weed species. At an aspen symposium in Ft. Collins in 1976, a Forest Supervisor stated that "many who talk of managing aspen for the totality of its ability to provide both a viable forest environment and as an economically feasible wood are generally considered heretics or at best, troublemakers."

Fortunately this quote is not as true today as it was in 1976 or we would not be having this particular panel topic today.

When looking at the basic silviculture of aspen it would appear that aspen is an easy species to manage but this is not the case.

Since no single value fully dominates in aspen, management is complicated. It is economically, traditionally and socially much more difficult to manage a type like this than a type associated with a dominant use. Its value as a wood producing tree has been greatly overshadowed by abundant conifer forests. I work on a district where we actively manage 6 species of trees and aspen presents the biggest challenge and the most frustration. Tradition and economics have prevented management of species such as aspen with low or negative dollar value as sawlog stumpage.

The San Juan National Forest has had a history of aspen harvesting since 1946 when an aspen match stick plant was built in Mancos, which is about 50 miles west of Durango. The plant is now owned by Ohio Match of Wadsworth, Ohio and it is their only source of sticks. The aspen plant requires a high quality log on its veneer lath so as a result it utilizes only 50% of the volume delivered to their yard. In order to utilize this excess volume a somewhat diversified aspen industry has evolved in southwestern Colorado. Products include pallets, lumber, excellsor, shingles, decking, panelling, mine props and firewood.

A new product was added to this list when a chop stick factory was opened last summer in Espanola, New Mexico and some of our logs are now going there. When the manager first called me about chop sticks I thought it was a prank call from another forester. I doubt if we can depend on chop sticks to help us in aspen management but you never know. Who would have thought 5 years ago that Colorado would have 2 waferboard plants.

The San Juan is presently harvesting 5-6 MMBF of aspen/yr. This amounts to about 600 acrs of cc/yr. A cyclic aspen market, high roading building costs & overmature stands are the major barriers

facing District foresters.

Insects and diseases are also of concern. Aspen is probably the host for more insects and diseases than any other species. Aspen is host to 300 different insects and over 250 diseases. Fortunately few insects and diseases kill aspen.

Aspen insects are the main reason I am here today and I want to present an overview of a western tent caterpillar outbreak on the Pagosa District. Much of what I will say is personal opinion although most people at the District & Forest level who have been involved with this outbreak would agree with me. I feel that some unfortunate decisions were made because of tradition and a non multiple resource approach to aspen management. Tradition has an important role in our profession but tradition can also result in tunnel vision.

In 1976, during a routine fire patrol flight, several hundred acres of aspen defoliation were detected about 25 miles south of Pagoa Springs near the Colorado-New Mexico state line. In 1977, defoliation had increased and entomological assistance was requested. Three years later in 1979, 10,000 acres of aspen were being defoliated. Historically, most tent cat outbreaks drop out due to viral diseases but there was no evidence of the virus in this population. After 4 years of defoliation, branch kill was occurring in 5-10% of the trees. At this point 50 MMBF of aspen were being affected.

In the fall of 1979, the Forest requested $100,000 in suppression funds for aerial application of Bacillus thuringiensis on 10,000 acres of Federal lands. Unfortunately, no suppression action was taken because by the time we had completed all the necessary paperwork and had prolonged discussions on the need for suppression we were told that industry could not supply the B.t.

Since 1981 we have continually requested suppression funds but none have been available because of higher priorities.

As of 1984 the infestation has reached 94,000 acres gross and is on both the San Juan and Rio Grande National Forests and on private lands. From the start of the outbreak, it was thought that virus would cause a population drop before stand damage occurred. To date, there has been no significant incidence of virus and unfortunately the caterpillars will be going strong again this summer.

The present condition of the stand is variable depending on years of defoliation, site and stand age.

Where defoliation has occurred for the past 6-8 years there is significant branch and tree mortality. Growth reduction has been more than 60% and the area really has a ratty appearance.

Within the outbreak area we have numerous clear cuts that were cut in the late 1960's and early 70's. Prior to any defoliation, sapling height growth in the clear cuts was 2-4'/yr. Defoliation has reduced height growth by at least 75%. Aspen saplings are very susceptible to

snow damage. Since these saplings are putting on very little radial growth they are just standing there year after year in the sapling stage and incurring an abnormal amount of snow damage. The result is a lot of deformed trees.

One of our biggest concerns was that the stands would lose their ability to sucker after continued defoliation. In 1983, we clear cut an area as part of a firewood sale to see if the site would produce suckers. AND IT DIDN'T. We know that this isn't a sufficient sample but it does increase our concern.

I wish I could tell you what this area will look like in 10 years but I can only speculate that much of the area will breakup as tree mortality will continue even after the bugs drop out because of the ramifications of branch kill and loss of vigor. This will result in increased pathogen, wood borers, wind and mechanical damage. I don't think that the next generation of foresters in Pagosa will appreciate what we left them.

I would like to close with the following thoughts.

1. A realistic economic analysis of aspens multiple use value is a real challenge.

2. If we are going to actively manage aspen decisions will have to be made incorporating all of its values

3. Bark beetles and conifers have a higher priority for suppression projects.

4. Public support for this suppression project was great but unfortunately you also need political support which we did not have.

5. We need to do a better job of quantifying the impact of continued defoliation.

6. We cannot assume that the virus will naturally control tent cat outbreaks within 3-5 years.

7. Much of the decision making at the District level relied heavily on Milt Stelzers work in 1968 entitled "The Great Basic Tent Caterpillar in New Mexico". This kind of research is really beneficial to District foresters and I encourage you to do more of it.

Panel: Aspen Management in the Southern Rockies
Moderator: Jim Beavers

Wayne D. Shepperd

My objective today is to discuss several questions about the current state of aspen management in the Rockies from a silvicultural point of view, and in the process give you a bit of review of the state of the art of aspen silviculture in the Rocky Mountains.

First, what's the situation from a silvicultural point of view? As Jim has told you, we are dealing with a large aspen resource. There are nearly three million acres of aspen in Colorado alone. Second, aspen is a species of wide ecologic amplitude. That is a fancy way of saying it grows over a wide range of elevation, precipitation, soil types, and in association with many other species. In fact, aspen is one of the most widely distributed tree species in the world.

Aspen also has a number of unique growth characteristics. It is intolerant or sun loving. Its primary means of reproduction is by asexual root suckering (although abundant viable seed is produced by aspen, very few find the moist mineral soil conditions needed to survive). As many of you know, aspen is susceptible to insect and disease attack. (i.e., extremely biodegradable). It is also self thinning. The 30 thousand or so suckers per acre at age one will naturally be reduced to 200-400 stems at maturity.

What do these things mean when we try to "culture" aspen? First, it means any regeneration method we use should give the new suckers lots of light. Because we are depending upon sprouting, we should provide sufficient hormonal stimulation to result in adequate sucker production. We should also watch out for the root system during any management activities. If we kill or destroy the roots, we have lost the ability to regenerate the clone. Remember that we can't fall back on artificial regeneration. Finally, we don't want to do anything later to damage the new stand or increase its susceptibility to disease. In commercial stands this means we should not attempt multiple entries per rotation to harvest the stand.

Now that we know what we have to do silviculturally, what techniques can we use to regenerate aspen? In fact, anything catastrophic usually works. There are a number of techniques which have successfully regenerated Rocky Mountain aspen:

1. Commercial clearcutting - Sawlogs, fiber, and firewood. All submerchantable and cull stems should be felled to maximize suckering and growth.

2. Non-commercial clearcutting - Felling of unmerchantable stands with no utilization of the cut trees. Avoid large concentrations of slash which can inhibit suckering.

3. Burning - Possible in stands with oily shrub understories, mixed conifer/aspen stands, and those with heavy fuel loadings.

4. Herbicides - Either aerial application or direct injection can be used.

5. Bulldozing - Stems must be tipped out of the ground. The dozer blade should not cut into the soil and destroy the lateral root system.

6. Nothing - Remember that some stands are self-regenerating and can reproduce themselves without any intervention.

7. Fencing - Protection from browsing animals is all that is necessary to adequately regenerate some stands.

8. Cut conifers - Many opportunities exist to reestablish aspen by removing conifer overstories in mixed or late seral aspen/conifer stands where some aspen root system remains.

When do you do what to regenerate aspen? It depends on what you've got to work with. Existing stand conditions, genetics, physiographic and ecologic limitations can all limit the regeneration options available. We can expect that vigorous, healthy stands will be easier to regenerate, but poorly stocked, low-vigor stands will require more care.

Choice of regeneration method also depends upon what you want. If we only want to perpetuate the species on a site; maximum stocking or growth is not necessary, and we can choose any method which results in at least some surviving sprouts. If, on the other hand, we wish to perpetuate a stand condition (sprouts, old-growth, snags, vertical, horizontal, or age class diversity, etc.) or provide a specific resources (fiber, water, forage, habitat, landscape character, etc.), we must be careful to choose a method of regeneration which can meet our objectives. Finally, the choice of regeneration method depends on what we can afford to do. Things that don't cost us taxpayers a lot of money, like doing nothing or commercial logging, are much more cost effective than force account felling or bulldozing, for instance.

In conclusion, aspen is capable of providing us with a great many things which can benefit a number of resources, providing we are willing to accept its silvical requirements and limitations.

WESTERN FOREST INSECT WORK CONFERENCE 1985

Outline of comments by Robert R. Kelley, Resource Conservation Director, Colorado Wildlife Federation, regarding the opportunity for more intense management of aspen in Colorado.

Good to see old Duke University forestry friends here like Dave Leatherman. Even Jim Beavers (panel moderator) is a Blue Devil! I may really disappoint this crowd because even though I have been billed as the radical opposition here, our Wildlife Federation is not very radical. We even believe some of this aspen management can be helpful to wildlife. We do understand public concern re. air quality and the operation of waferboard plants in towns like Montrose and Kremmling where perhaps clean, fresh air is too often taken for granted; for perturbations to the watersheds affecting agriculture and domestic drinkability. We understand the opportunities and needs, but are concerned about sudden pressure, sudden changes in management plans, and bad stories about John Crowell.

The Board of Directors of the Colorado Wildlife Federation has adopted an aspen management policy or position statement (copy attached). The primary points of this position are as follows:

1) Aspen in Colorado are priceless resource vital to scenic and wildlife values.

2) Aspen must be managed in a fashion which will maintain them. Some disturbance is necessary.

3) Aspen cutting for product production is the only economic means and is therefore supported.

4) Management must be done for the primary purpose of securing the regeneration of the species and its attendant values.

5) Road access must be controlled more successfully than the USFS has been able to do in the past.

6) The hydrologic balance of the watershed must be protected.

7) Nutrient cycles must be respected to the point of controlling time of harvest.

We distrust false wildlife goals, e.g. ruffed grouse!, but are very appreciative of the general wildlife cognizance. We applaud Louisiana-Pacific in their stated desires to go after (harvest) the real culprits, too - the conifers (lodgepole)!

In summary, however, we are much, much more concerned about the rumored proposals from Washington (D.C.) involving the massive USFS/BLM land exchanges!!!

Choristoneura taxonomy

A group interested in taxonomy of conifer-feeding Choristoneura met during the 1985 Western Forest Insect Work Conference, held 5-7 March at Boulder, Colorado. The meeting served to educate all of us as to the complexity of the situation, by hearing about problems in other geographic areas with which we were not previously familiar. The following generally records the items discussed.

A number of questions have existed regarding taxonomic relationships among populations of conifer-feeding Choristoneura (Lepidoptera: Tortricidae) budworms. This is important in view of the fact that two generally recognized "species", C. fumiferana (Clem.) and C. occidentalis (Freeman), are major forest pests in eastern and western North America, respectively. C. pinus Freeman is a moderately important pest of pines in the States and Provinces in the vicinity of the Great Lakes.

It is generally recognized that conifer-feeding Choristoneura consist of two series; one (Fumiferana complex) associated with spruces and firs and the other (Lambertiana complex) associated with pines.

A fair amount of work on taxonomic relationships has been carried out recently in both the U.S. and Canada in part under the aegis of the Canada - U.S. Spruce Budworms Program (CANUSA). Also, studies have been greatly facilitated by development of synthetic sex pheromones for certain species groups during the past 10-year period. The status of most of these entities was reviewed by Powell (1980), Powell and De Benedictis (1982) and in the CANUSA Research Symposium Proceedings by Harvey (1985).

Several of the researchers involved believed that it would be useful to have an informal meeting at which progress could be reported and outstanding questions discussed. The CANUSA Research Symposium was not appropriate for such a session, but an opportunity was afforded by the annual meeting of the Western Forest Insect Work Conference. A 1/2-day workshop was devoted to budworm taxonomy. The workshop was organized by a group consisting of George Harvey, Jerry Powell, and the writer. Powell led the discussion. Participants are listed at the end of this report. The discussion was informal and a summary per se is not provided; however the following are major areas that we defined as needing further study.

A. General items (pertaining to all conifer-feeding Choristoneura entities)

1. A summary is needed of the current state of our knowledge of the natural sex pheromone blends in the different Choristoneura entities, including evidence for minor components.

2. All references to trapping with synthetic pheromones should include complete information on blends used, and if possible an estimate of release rate.

3. For all entities more knowledge is needed of pre-mating factors and the extent to which they result in reproductive isolation between sympatric pairs. These factors include host differences, and

temporal and geographic separation. Although well recognized for the major pest species, they are not described for other members of the genus.

4. The continuing and critical need for voucher specimens of adults for morphological examination from all studies was recognized, particularly from pheromone trap catches in strategic locations related to sympatries. Such specimens can be examined by P. T. Dang or Jerry Powell, or others.

B. Fir- and spruce-feeders

1. The identity of populations of fir-feeders commonly considered "occidentalis" and/or "retiniana" remains in doubt in the following areas:

   a. Southern Oregon north to the Okanagan Valley
   b. Utah border north into Idaho
   c. Northern Arizona, particularly north and southeast from Flagstaff

   Resolution of these questions could involve:

   (1) cross-attraction studies using virgin females and synthetic pheromones and (2) obtaining reared series of adults from different larval morphs (e.g. green vs. brown), and from different hosts.

2. C. biennis and C. orae present problems as they interface with other species entities, as follows:

   a. biennis - fumiferana
   b. biennis - occidentalis
   c. biennis - orae
   d. orae - fumiferana

   These relationships need resolution using rearings and attractant studies as in B.1. above. In addition, the following special lines of work are suggested:

   e. biennis - fumiferana (Pine Pass) isozyme studies, study of hybrid morphs
   f. orae - fumiferana (Watson Lake) isozyme studies, seasonal separation of populations, and hybrid morphs. C. orae should be offered baits attracting both fir and pine-feeding forms.
   g. orae - lambertiana - retiniana; cross tests of pheromone blends are needed.

C. Pine-feeders

1. As in the spruce- and fir-feeders, identity/morphology questions exist as follows:

a. lambertiana maculation differs throughout the species range in the Rocky Mountain - Great Basin arc. Studies are needed to clarify the geographical distributions of the various forms.
b. There are poorly-known populations of pine-feeders in (1) Alberta, and (2) coastal Oregon-Washington-British Columbia. Their relationships to the lambertiana complex needs to be clarified.

In all of these, trapping with virgin females and synthetic pheromones would be appropriate, along with rearings from different hosts. Larval and pupal characteristics (color, etc.) are poorly known in this group.

D. Further action

The group did not develop specific plans for action to answer needs or questions identified in these discussions. It is hoped that as many of the participants as possible will direct some effort to meeting identified needs in areas accessible to them, either in person or through student projects, etc. Help from other researchers is, of course, also welcome--discussion with participants should help provide additional details of specific problems or points in the group discussions. A more concentrated effort to resolve aspects of pheromone identities may be needed and will require spearheading by pheromone researchers.

It was agreed that an attempt would be made to hold a similar informal workshop in about 4 years (1989) to assess progress and identify continuing needs.

Participants	Affiliation
Robert Averill	U.S. Forest Service, Denver, Colorado
Roy Beckwith	U.S. Forest Service, LaGrande, Oregon
Karen Clancy	U.S. Forest Service, Flagstaff, Arizona
P. T. Dang	Biosystematics Research Institute, Ottawa
John DeBenedictis	University of California, Berkeley
George Harvey	Canadian Forestry Service, Sault Ste. Marie, Ontario
Ed Holsten	U.S. Forest Service, Juneau, Alaska
John McLean	University of British Columbia, Vancouver
Ben Moody	Canadian Forestry Service, Edmonton
Paul Opler	U.S. Fish & Wildlife Svc., Ft. Collins, Colorado
Jerry Powell	University of California, Berkeley
Chris Sanders	Canadian Forestry Service, Sault Ste. Marie, Ontario
Roy Shepherd	Canadian Forestry Service, Victoria, British Columbia
Lonnie Sower	U.S. Forest Service, Corvallis, Oregon
Robert Stevens	Colorado State University, Ft. Collins, Colorado
Molly Stock	University of Idaho, Moscow
Jon Sweeney	University of British Columbia, Vancouver
Jan Volney	University of California, Berkeley
Skeeter Werner	U.S. Forest Service, Fairbanks, Alaska

Robert E. Stevens
Recorder

WORKSHOP: WILL TRAP TREES REDUCE SPRUCE BEETLE POPULATIONS?
Moderator: Ken Gibson
Participants: Seventeen participants representing the USDA, Forest Service; Canadian Forestry Service; British Columbia Ministry of Forests; universities; and private industry

Some controversy over the use of trap trees to control spruce beetle outbreaks has existed since their use was first advocated in the 1950's. Recent spruce beetle epidemics in the Northern Region (northwestern Montana and northern Idaho) and Canada have afforded pest managers the opportunity to recommend the judicious use of trap trees and observe the results of their use. This information should better enable us to address the efficacy of trap trees at this time than at any time in the recent past.

Ken Gibson presented results of trap-tree programs conducted in Montana and Idaho (both on Federal and State lands) during 1982, 1983, and 1984. Peter Hall described similar programs from the past 2 years in British Columbia. In virtually every case those programs were successful in reducing beetle-caused mortality where trap trees were used in accordance with current recommendations. Peter also detailed their use of "lethal" trap trees--those injected with a herbicide prior to being felled--which will kill developing broods. These trees, then, do not have to be removed. The herbicide is not registered for that use in the U.S., so this option is not currently available to U.S. forest managers.

Jim Linnane detailed current spruce beetle outbreaks in the Southwestern Region (Arizona and New Mexico). There, various sets of conditions have resulted in infestations developing beyond the point where the use of trap trees presents a viable management option for controlling the infestation if trap trees are the only control method. There is some reluctance to use trap trees because of the "risk" associated with their use. That "risk"--the likelihood of aggravating an infestation if trap trees are not removed prior to beetle emergence--is a very real management concern, and one which must be addressed any time trap trees are used.

As a group we discussed prevailing strategies for the management of old-growth spruce stands, the impacts spruce beetles can have on those stands, the effects of beetle populations on stand management, and the important role trap trees can have in reducing beetle popuations. We described the characteristics of trap trees: among the largest live trees in the stand, dropped singly or in small groups in the shade where possible, and left unlimbed and unbucked to enhance their attractiveness to the beetle. We discussed the number of trap trees needed for any particular infestation and agreed that the number will depend on the number and size of currently infested trees, the number and size of susceptible green trees, and beetle population estimates. In general, trap trees will be used in the ratio of one trap to five standing infested trees, up to one trap tree for every two standing infested ones. Finally, we agreed on the need for an absolute commitment on the part of the land manager to remove the trap trees

once they are infested. Should there be doubt about their removal, they should never be cut.

A few additional points of general agreement were:

1. Assessing the effectiveness of trap trees may be difficult without comparable areas in which they were not used.

2. The use of trap trees (including the removal of natural windfall) can be an effective program of preventive management in endemic spruce beetle populations.

3. The use of pheromone-baited trap trees is not recommended. Data showing that baits significantly enhance the natural attractiveness of trap trees does not currently exist.

In answer to the question with which we began: "Will trap trees reduce spruce beetle populations?," we concluded the answer is "yes." The use of trap trees can be an effective tool in the management of beetle outbreaks; however, the land manager must be willing to integrate those sound silvicultural and entomological principles upon which their success in based.

WORKSHOP: INSECT IMPACT ON SEED PRODUCTION

Moderator: Raymond C. Shearer

Participants: Jan Volney, Nancy Rappaport, John Schmid, Mike Wagner, Liz Blake, Tom Koerber, Larry Stipe, Tim Schowalter, Charles Sartwell, David Overhulser, Gordon Miller (presented by Ladd Livingston), Mary Ellin Dix, and Ray Shearer

Volney and Rappaport, U. CA., Berkeley. Fogbelt of coastal CA; development and feeding of insects (particularly seed chalcid and cone moth) and between-insect competition and relating this to phenological events during Douglas-fir cone development.

Schmid, RM, Fort Collins, CO. Several locations in AZ. Leptoglossus and other insects are causing heavy losses. Now studying insects damaging spruce cones on Fraser Exp. For., CO.

Wagner and Blake, N. AZ U., Flagstaff. Plots established by J. Schmid in AZ. Determining insects feeding on ponderosa pine cones and seeds. In 1984, cone mortality ranged from 20 to 100 percent; Dioryctria caused up to 88 percent of the losses.

Koerber, PSW, Berkeley, CA. Studying insects and cone production in Oregon Douglas-fir seed orchards. Also, developing tree injection methods with orthene in metacaps to protect cones-effective on seed chalcid and cone moth. Will try on ponderosa pine seed trees to maximize seed fall.

Stipe, R-1, CF&PM, Missoula, MT. Responsible for seed production improvement activities. Studying impact and damage of insects on white pine seed orchards in Idaho. Implant early to protect cones from budworm because it takes three weeks to translocate to crown.

Schowalter, OR S. U., Corvallis. Survey of insects affecting 17 Douglas-fir seed orchards in WA, OR and CA. The gall midge most damaging, seed chalcid is second, Dioryctria is third, and seedbug may be involved.

Sartwell, PNW, Corvallis, OR. Working on microbial pheromone control of budworm and tussock moth. Techniques of managing Dioryctria using pheromone attractants and testing BT on Douglas-fir cone moth and gall midge.

Overhulser, Office of OR S. F., Salem. In 1981, studied seedbug damage in Douglas-fir. Difficult to assess damage from indistinct external symptoms (e.g., holes, collapsed seed coat) because not all damaged seed show symptoms.

Miller, P.F.R.C., Victoria, B.C. Most cone and seed insect work centered on developing techniques for monitoring populations: ways to catch adult Douglas-fir cone moth, calling behavior of cone moth and spruce seed moth, and Douglas-fir cone gall midge.

Dix, R.M. Lincoln, NE. Working on insects decreasing ponderosa pine cones and seeds in the central Great Plains. Developing life history of Leptoglossus and Dioryctria in association with the phenology of the trees.

Shearer, INT, Missoula, MT. Determine causes of poor western larch seed production in Idaho, including insect damage. Wooly aphid, cone maggot, and budworm can cause severe damage. Previously identified budworm cone moth and cone worm causing heavy damage to Douglas-fir seeds.

WORKSHOP: GEOGRAPHIC INFORMATION SYSTEM DEMONSTRATION

Moderator: Bill White

Participants: Bill Kendall, Dawn Radtke, Bruce Morse and Don Hunter

The U.S. Fish and Wildlife Service, Western Energy and Land Use Team demonstrated a Data General desk top microcomputer as a stand alone geographic information system (GIS) work station. A subset of the Nicolet National Forest's GIS data base was used in an interactive mode to show the ability of the microcomputer to store, analyze, and display map data.

The demonstration was further enhanced by presenting an operational risk rating system employing the Nicolet National Forest's data base and the subject microcomputer. A brief write up of the risk rating system, developed by Bruce Morse, University of Minnesota, is presented below.

Risk Rating For The Saratoga Spittlebug With The Assistance Of A Geographic Information System

Computer mapping using a geographic information system (GIS) is assisting in risk rating of several major forest pests on the Nicolet National Forest, Wisconsin. The Map Overlay and Statistical System (MOSS), which runs on a Data General microcomputer, was the GIS employed. The Nicolet National Forest has a digitized database which includes the following themes or maps: timber stands, ecological land types, elevation, lakes and streams, cultural features, wildlife habitats, and roads.

The Saratoga spittlebug is one pest which has been risk rated using MOSS. The rating is based on the occurrence of nymphal and adult hosts. Significant populations of nymphs develop primarily on sweetfern, which commonly grows on sandy soils. Economic damage by the adults occurs only on small (<15') red pine, grown near sweetfern; therefore, high risk stands exist whenever small red pines are planted on sandy soils. MOSS assists in locating these high risk stands by selecting only small red pine stands from the master timber stand map and selecting sandy soils from the ecological land type map. These two selected maps are then overlaid to locate susceptible stands of small red pines growing on sandy soils. A conceptual model of this risk rating processing using MOSS is outlined in Figure 1. The location of these high risk stands will be a valuable aid in survey and control operations for this important forest pest.

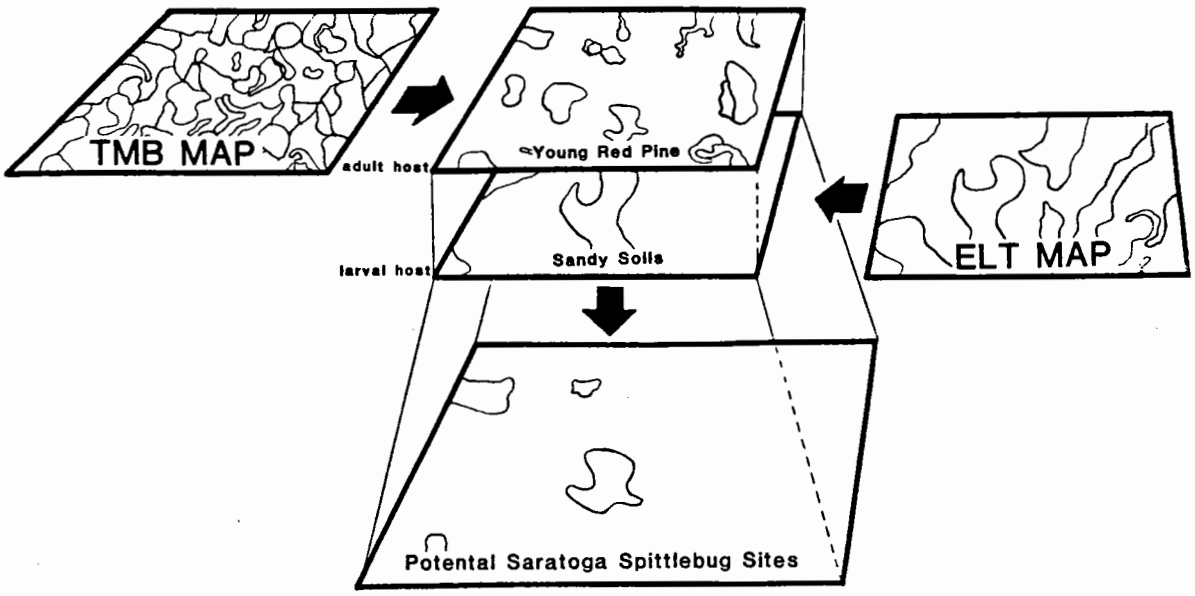


Figure 1. Conceptual model for identifying and locating stands susceptible to the Saratoga spittlebug using the MOSS geographic information system.

Young red pine and sandy soils are selected by MOSS from the TMB Map (Timber Stand) and the ELT Map, (Ecological Land Types), respectively. These two selected maps are then overlaid by MOSS to produce a final map locating stands with a high risk to the Saratoga spittlebug.

WORKSHOP: AERIAL PHOTOGRAPHY FOR DETECTING AND ASSESSING FOREST INSECT PROBLEMS
Moderator: Richard J. Myhre

The workshop started with a slide presentation on the applications of aerial photography for insect problems. Aerial photography has been used as a management tool to: (1) estimate current damage or mortality; (2) estimate total levels of mortality; (3) monitor rate of spread and trends; and (4) evaluate effects of treatment (chemical, cultural, and biological). Slides were shown that illustrated how aerial photography can be used for each of these applications.

The next phase of the workshop was a presentation and discussion on the basics of aerial photography. The basic elements include:

Types of Aerial Photography - There are basically two types of photo coverage - mapping photography and sampling photography. Mapping photography is best defined as continuous photo coverage over a large area for the use of detecting and mapping an insect problem. Sampling photography is photo coverage of small selected areas, usually in conjunction with some type of sampling design or stratification technique. The samples may be ground plot locations, polygons representing stands of a host type, or random samples within an area of an insect problem.

Photo Scales - The most commonly used scales for intensive evaluation of an insect problem range from 1:6,000 to 1:12,000. Scales of 1:16,000 to 1:30,000 are used for general detection and assessment of large areas.

Film Types - Color and color infrared films are used for most insect applications. The advantages and disadvantages of these two films must be evaluated according to the specific pest problem. The overall advantage of color infrared is its superior haze penetrating ability over normal color film.

Camera Systems/Film Formats - Cameras with film formats of 9x9 inch, 70 mm, and 35 mm have been applied to forest insect work. Both mapping and sampling photography can be acquired with 9x9 inch format cameras, while 70 mm and 35 mm cameras are usually used for only sampling photography.

Navigation Aids - Photo missions can be flown using either visual reference aids (maps or aerial photos) or electronic navigation systems such as Loran-C.

A majority of the workshop participants were young professionals who were enthusiastic about the possible uses of aerial photography in their field, yet expressed concern that they lacked sufficient background for using aerial photos. Many of these individuals stated that they had not received enough college course work in the use of aerial photography. This may be a signal to the profession of entomology that this is an area where technology transfer and training is lacking. A possible solution would be seminars, training sessions, and intensive workshops on the practical applications and techniques in using and interpreting aerial photography.

WORKSHOP: INSECT-DWARF MISTLETOE ASSOCIATIONS

Moderator: Frank G. Hawksworth

Participants: About fifty, including entomologists and pathologists.

The subject of dwarf mistletoes predisposing conifers to insect attack is timely because Bob Stevens and I recently summarized the literature in this field.[1] There are more than 100 publications on the subject but most of them are observational with little or no quantitative data. It seems to be generally agreed that many "secondary" insects (Ips, Melanophila) are associated with killing of heavily diseased trees. However, the association of "primary" bark beetles (Dendroctonus) is more complicated and varies with the insect species, the host tree, geographic area, and environmental factors.

Three general types of associations were noted:

1. Heavily infected trees that are more susceptible than non-mistletoed trees: Mountain pine beetle in ponderosa pine, Western pine beetle in ponderosa pine, Jeffrey pine beetle in Jeffrey pine.

2. Little or no change in susceptibility in mistletoe infected trees: Douglas-fir beetle in Douglas-fir, spruce beetle in Engelmann spruce.

3. Mistletoe-infected trees that may be less susceptible than non-mistletoed trees: Mountain pine beetle in Rocky Mountain lodgepole pine.

Dave Schultz suggested that lodgepole pine in the Sierras infected by dwarf mistletoe is more susceptible to the mountain pine beetle than mistletoe-free trees. Jerry Beatty noted a complex (spruce budworm-Douglas-fir beetle-dwarf mistletoe-root rots) was involved in killing Douglas-fir in the Sangre de Christo Mountains of New Mexico. Bob Scharpf noted an apparently unique situation in the Laguna Mountains in Southern California in which flathead borers are associated with dying mistletoe-infected Jeffrey and Coulter pines, especially after drought. Brian Geils reported that, in a study in the Boise National Forest in Idaho, over 90% of the Douglas-firs killed by the Douglas-fir beetle had high dwarf mistletoe levels. Mike Wagner and Bob Mathiasen noted that heavy defoliation by pandora moth in ponderosa pine in northern Arizona was fatal only to trees heavily infected by dwarf mistletoe. Bob Scharpf reported that Dick Parmeter has found that dwarf mistletoe bole infections in ponderosa pine in California are frequently colonized by the red turpentine beetle. Dave Leatherman found that twig beetles (Pityogenes) were common in mistletoe-infected and winter-damaged ponderosa pine in Colorado.

---

[1] Stevens, R. E., and F. G. Hawksworth. 1984. Insect-dwarf mistletoe associations: an update. p. 94-101. In Biology of dwarf mistletoes: Proceedings of the Symposium [August 8, 1984, Fort Collins, Colo.]. USDA Forest Service General Technical Report RM-111.

Several participants noted the increased awareness that tree killing is frequently caused by complex of entomological, pathological, and environmental causes. Even though a complex may be involved, it is still important to know the individual components of the complex, because some elements may be minimized by cultural means. For example, removing heavy mistletoe-infested ponderosa pines should reduce stand susceptibility to mountain pine beetle.

It was concluded that much more research is needed to quantify the interactions of bark beetles and dwarf mistletoes in tree killing. Dwarf mistletoe intensity, not just presence or absence of the parasite, should be determined. Studies under endemic beetle conditions are particularly needed.

WORKSHOP: PLANTATION INSECT PROBLEMS
Moderator: Thomas Koerber

The workshop attracted 26 participants, eight of whom made presentations. Mike Wagner reported the establishment of a 5-year study to evaluate the effects of Rhyacionia neomexicana infestation and grass competition in northern Arizona. Four plots have been established on two soil types. It has been established that R. neomexicana will attack 1 year old trees.

Ladd Livingston reported on successful tests of hand laid pheromone strips for protection progeny test sites from infestation by Eucosma sonomana. A combination of dococenyl acetate isomers which matches the pheromone produced by female moths and a cheaper mixture (Phillips Blend) which does not match the authentic female product were equally effective. Percent control ranged from 39 to 85 percent with the natural mix and 16 to 89 percent with the Phillips Blend.

Tom Koerber reported that aerial application of Phillips Blend Eucosma pheromone in Hercon flake formulation reduced infestation levels to seven percent of the tree terminals when adjacent untreated portions of the same plantation had 43 percent of the trees infested.

Al Robertson reporting for Bill Bedard and George Ferrell described preliminary work on Hylastes and Stremnius in Douglas-fir plantations. Both insects breed in stumps, roots and buried slash after logging. Maturation feeding by adults damages seedlings and black stain root disease may be transmitted. Pitfall traps, flight traps and emergence cages were used as potential population monitoring methods. Pitfall traps caught large numbers (2000+) of both Hylastes and Stremnius and about 200 Hylastes were taken in flight traps. Emergence cages caught very few insects.

Tim Schowalter also reported on the Hylastes/Stremnius/black stain complex. Stumps remain susceptible to black stain infection for 7-8 months after logging and are also attractive to Hylastes and Stremnius. Hylastes has been definitely associated with black stain transmission. Plots thinned from September to January have favorable conditions for black stain infection. Plots thinned in May escape infection.

Chris Niwa of PNW Forest Experiment Station will be testing a hand laid pheromone strip formulation for mating disruption of Rhyacionia zozona.

Judith Pasek of the Rocky Mountain Forest Experiment Station, Lincoln, Nebraska lab is working on the life history and flight habits of Rhyacionia bushnellii in relation to tree phenology.

Mary Ellen Dix of the same lab is working on the life cycle and pheromone chemistry of Petrova mettalica.

The meeting ended with a general discussion of the need for research on Pissodes terminalis in the inland empire. Growth losses up to 40 percent have been recorded.

THIRTY-SIXTH WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Final Business Meeting
Boulder, Colorado, March 7, 1985

Chairperson McLean called the meeting to order at 1:00 p.m.
The Treasurer's Report as of March 7, 1985 was read and approved.

Bob Stevens of the Common Names Committee reported on the proposed common name change for the western spruce budworm at the Choristoneura Taxonomy Workshops. The general concensus was that the taxonomists were casting considerable doubt on the future of C. occidentalis as a taxon, and that it might be premature to propose a name change and then to have to change it in 5 years if the status of C. occidentalis itself changes.

A vote from the floor was taken to see those who were in favour of pursuing the name change to Douglas-fir budworm (no one), those who wanted to seek an alternative common name (one vote), and those who voted to take no action and leave it as it is (the remainder of the 61 members present voted for this option).

Peter Hall presented the candidate selected by the Nominating Committee: Dave Overhulser, new councilor. The nominee was elected by acclamation of the general membership.

Roy Shepherd gave a special invitation for everyone to come to the 1986 WFIWC to be held in beautiful Victoria, British Columbia.

Chairperson McLean called for invitations for the 1987 WFIWC. Dave Holland nominated Utah for 1987. This invitation was accepted by all present.

Members were reminded of the following upcoming professional meetings: The Annual Meeting of the Entomological Society of Canada, in Ottawa, Ont. Sept. 23-25, 1985 and the International Congress of Entomology at U.B.C., Vancouver, B.C., July 3-9, 1988.

Bob Averill presented a report of the Ethical Practices Committee. Skeeter Werner, the last winner and Surrogate Chairperson was not present to give the new recipient the award. Again the number of canidates that qualified for nomination for the award were extremely low. However, one person, Dave Holland was observed impersonating a female with tights and skirt at Ladies Night in a Hilton Harvest Home night club, and dancing with members of various sexes.

It was proposed that a special thanks be given to the Hilton Harvest Home Hotel for its hospitality, Bill White and Barnie Raimo for a job well done and John Schmid and Dave Leatherman for organizing the workshops.

The meeting was adjourned at 1:30 p.m.

TREASURER'S REPORT

Thirty-sixth Western Forest Insect Work Conference
Boulder, Colorado, March 7, 1985

Balance on hand-March 4, 1985	(+)$1,874.61	
Expenses:		
Coffee and soft drinks	(-)	682.41
Stationery and Xeroxing	(-)	30.46
Meeting room rental	(-)	300.00
Food and drink for social mixer	(-)	856.12
Corsage for typist	(-)	10.59
Gratuity	(-)	5.00
Income:		
Registration(140,includes 12 students)	(+)$2,680.00	
Sale of 1984 proceedings	(+)	17.50
Sale of commemorative coffee mugs	(+)	74.75
Return on advance for mugs	(+)	7.40
Balance on hand march 7, 1985	(+)$2,769.68	

CONSTITUTION
OF
WESTERN FOREST INSECT WORK CONFERENCE

Article I Name

The name of this organization shall be the Western Forest Insect Work Conference.

Article II Objects

The objects of this organization are (1) to advance the science and practice of forest entomology, (2) to provide a medium of exchange of professional thought, and (3) to serve as a clearing house for technical information on forest insect problems of the western United States and Canada.

Article III Membership

Membership in this organization shall consist of forest entomologists and others interested in the field of professional forest entomology. Official members shall be those who pay registration fees.

Article IV Officers and Duties

The officers of this organization shall be:

(1) A Chairman to act for a period of two meetings, whose duties shall be to call and preside at meetings and to provide leadership in carrying out other functions of this organization.

(2) An Immediate Past Chairman, who shall assume office immediately upon retiring as Chairman without further election; whose duties shall be to fill the chair at any meeting in the absence of the Chairman; to act until the election of a new Chairman.

(3) A Secretary-Treasurer to act for a period of two meetings whose duties shall be to keep a record of membership, business transacted by the organization, funds collected and disbursed and to send out notices and reports. The Secretary-Treasurer is charged with the responsibility of preparing the proceedings for the conference in which his term of office is terminated (amended Feb. 28, 1967, Las Vegas, Nevada).

(4) An Executive Committee of six members, consisting of Chairman, Immediate Past Chairman, Secretary-Treasurer, and three Counsellors elected from the membership. Terms of office for the three Counsellors shall be staggered and for a period of three meetings each. The duties of this Committee shall be to carry out actions authorized by the Conference; to authorize expenditures of funds, and to establish policies and procedures for the purpose of carrying out the functions of the organization. The Conference registration fee will be set by the local Arrangements Committee in consultation with the Secretary-Treasurer and Chairman (amended March 4, 1965, Denver, Colorado).

The officers shall be elected at the Annual Meeting. Their periods of office shall begin at the conclusion of the meeting of their election.

The Chairman shall have the power to appoint members to fill vacancies on the Executive Committee occurring between meetings. The appointment to stand until the conclusion of the next general meeting.

It is the responsibility of a Counsellor, should he be unable to attend an executive meeting, to appoint an alterrnate to attend the executive meeting and to advise the Chairman in writing accordingly. The alternate shall have full voting privileges at the meeting to which he is designated.

Article V Meetings

The objectives of this organization may be reached by holding of at least an annual conference and such other meetings as the Chairman, with the consent of the Executive Committee, may call. The place and date of the annual shall be determined by the Executive Committee after considering any action or recommendation of the conference as a whole. The Secretary-General shall advise members of the date and place of meetings at least three months in advance.

Article VI Proceedings

A record of proceedings of conference shall be maintained and copies provided to members in such form as may be decided as appropriate and feasible by the Executive Committee.

Article VII Amendments

Amendmants to the Constitution may be made by a two-thirds vote of the total conference membership attending any annual meeting.

Prepared by Richard Washburn
March 20, 1969.