Thirty-Third Annual Western Forest Insect Work Conference

Proceedings

PROCEEDINGS

THIRTY-THIRD ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

MISSOULA, MONTANA

MARCH 2-4, 1982

Not for Publication

(For Information of Conference Members Only)

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Institute of Northern Forestry

Fairbanks, Alaska

PROCEEDINGS

THIRTY-THIRD ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

MISSOULA, MONTANA

MARCH 2-4, 1982

Executive Committee (Thirty-third WFIWC)

P. Buffam, Portland	Chairperson
W. Ives, Edmonton	Immediate Past Chairperson
R. Werner, Fairbanks	Secretary-Treasurer
M. Stock, Moscow	Councilor (1979)
S. Whitney, Victoria	Councilor (1980)
J. Laut, Fort Collins	Councilor (1981)
K. Gibson, Missoula	Program Co-chairperson
M. McGregor, Missoula	Program Co-chairperson
S. Tunnock, Missoula	Local Arrangements Co-chairperson
H. Meyer, Missoula	Local Arrangements Co-chairperson

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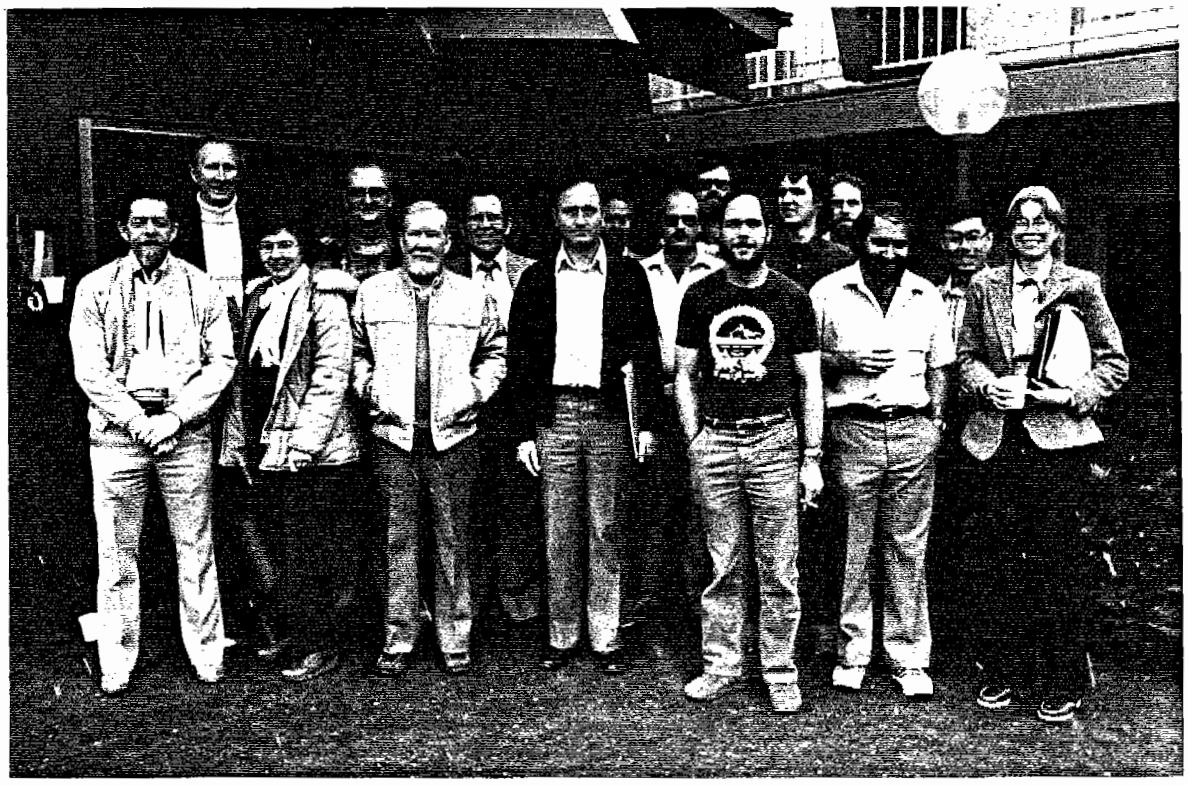
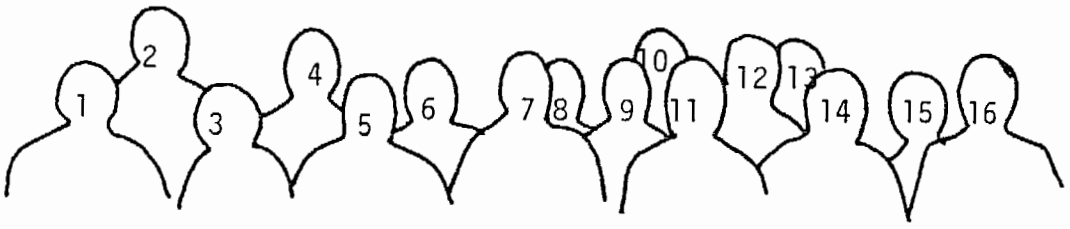
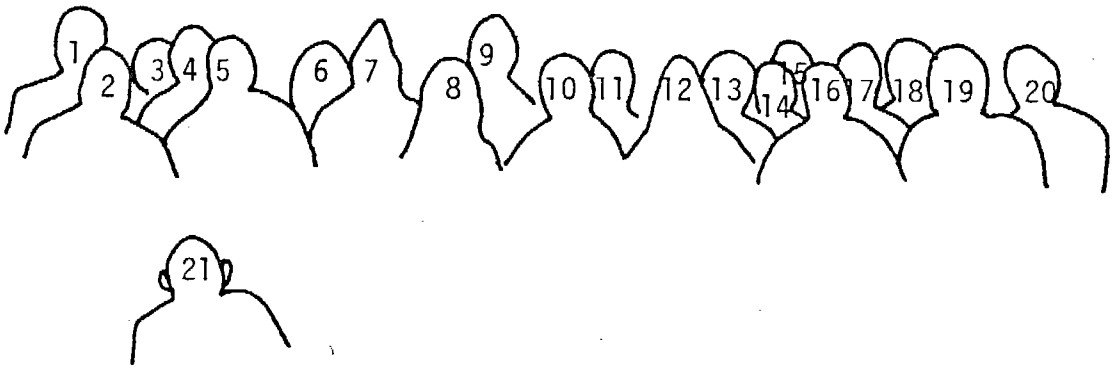
* Summary not submitted.





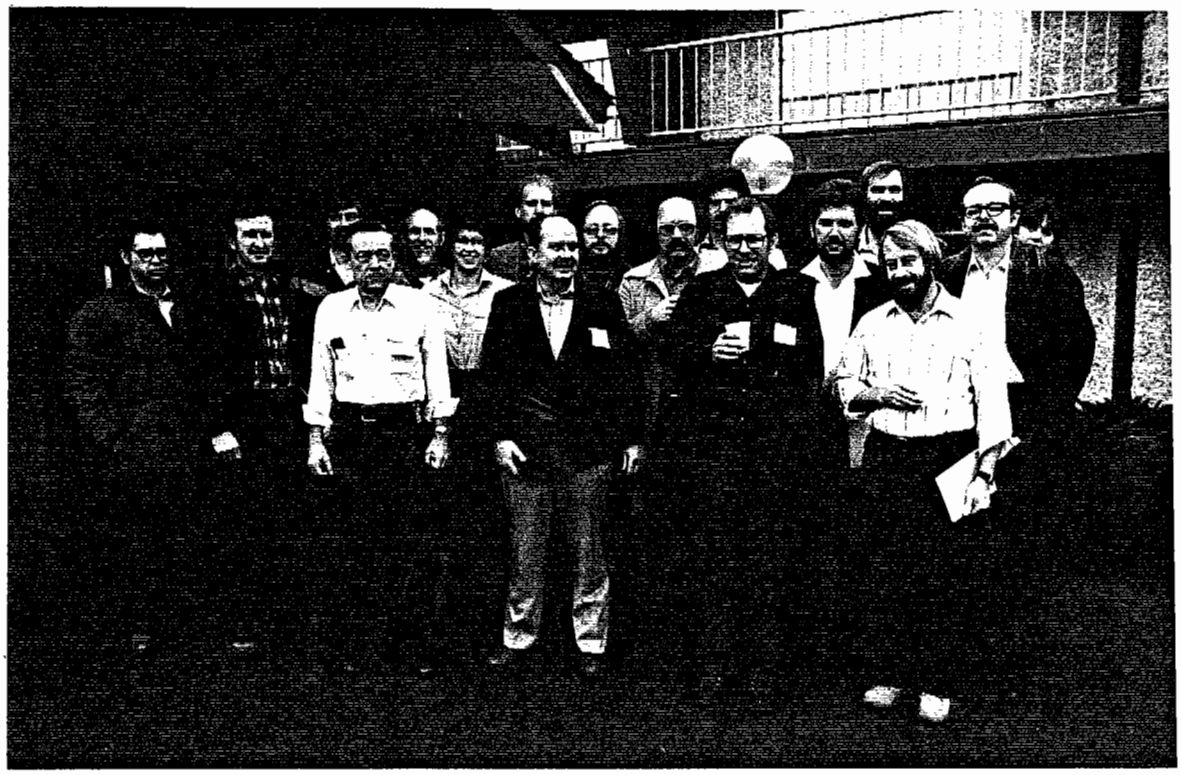
GROUP I

1. Walt Cole
2. Scott Tunnock
3. Carma Gilligan
4. Al Stage
5. David McComb
6. Les McMullen
7. Herb Cerezke
8. Ben Moody
9. Peter Hall
10. Evan Nebeker
11. Tom Maher
12. Dave Neale
13. Tom Adams
14. Gavin Moran
15. Gene Namkoong
16. Sharon Friedman



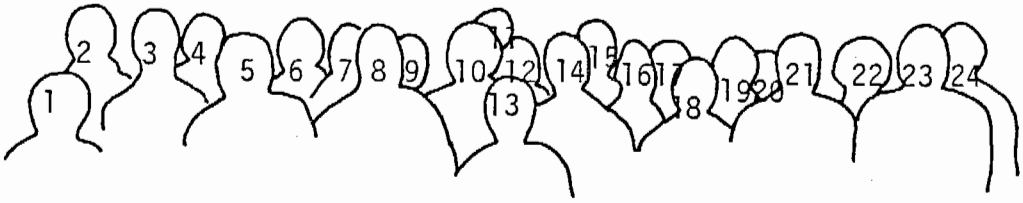
GROUP 2

1. Bill Ciesla
2. Bob Dolph
3. Jim Muldorew
4. Bob James
5. Dave Brochman
6. Kareen Sturgen
7. Oscar Dooling
8. Suzanne Dubreuil
9. Mike Wissenbach
10. John Wenz
11. Ken Gibson
12. Cathy Stewart
13. Jeff Padgett
14. Hubert Meyer
15. Tom Eager
16. Wayne Bousfield
17. Jerry Knopf
18. Gene Amman
19. Skeeter Werner
20. Ross Miller
21. Paul Buffam



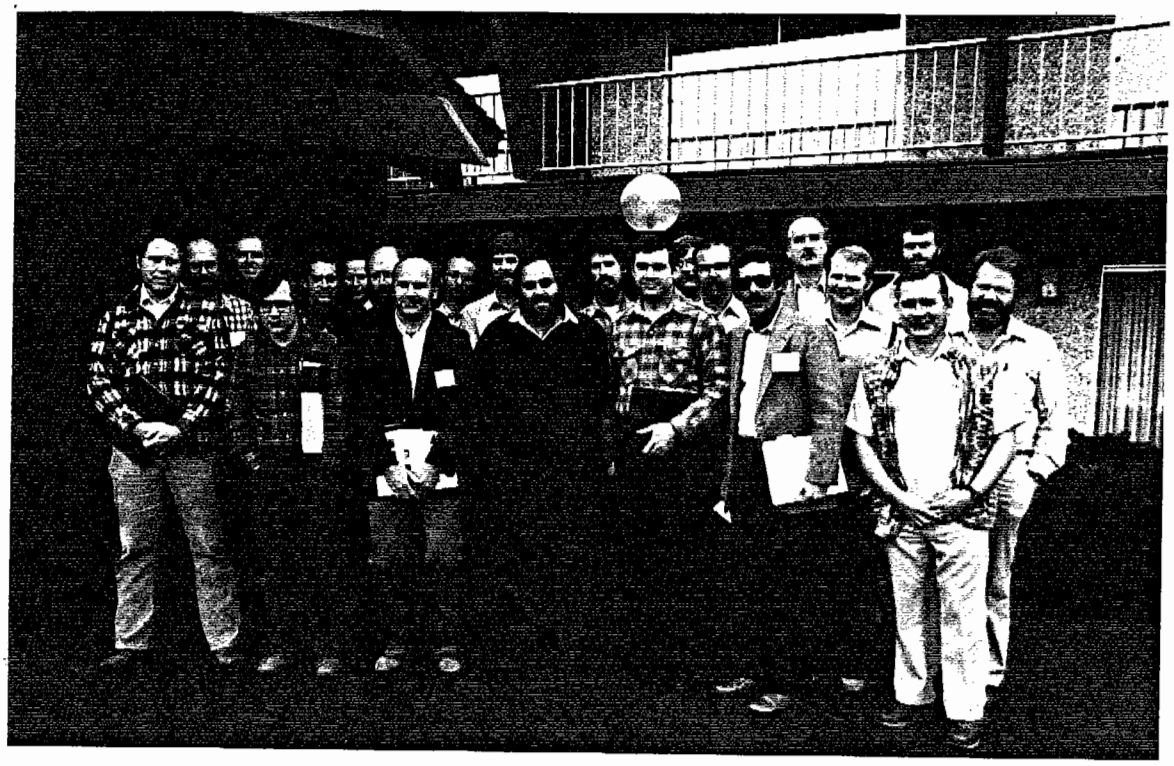
GROUP 3

1. Larry Stipe
2. Mark McGregor
3. Alan Berryman
4. Jack Schenk
5. Peter Lorio
6. Molly Stock
7. Jerry Carlson
8. John Pierce
9. Jim Davis
10. Terry Rogers
11. Richard Nathahson
12. Tom Payne
13. John McLean
14. Nick Crookston
15. Jeff Mittor
16. John Dale
17. Barbara Bentz



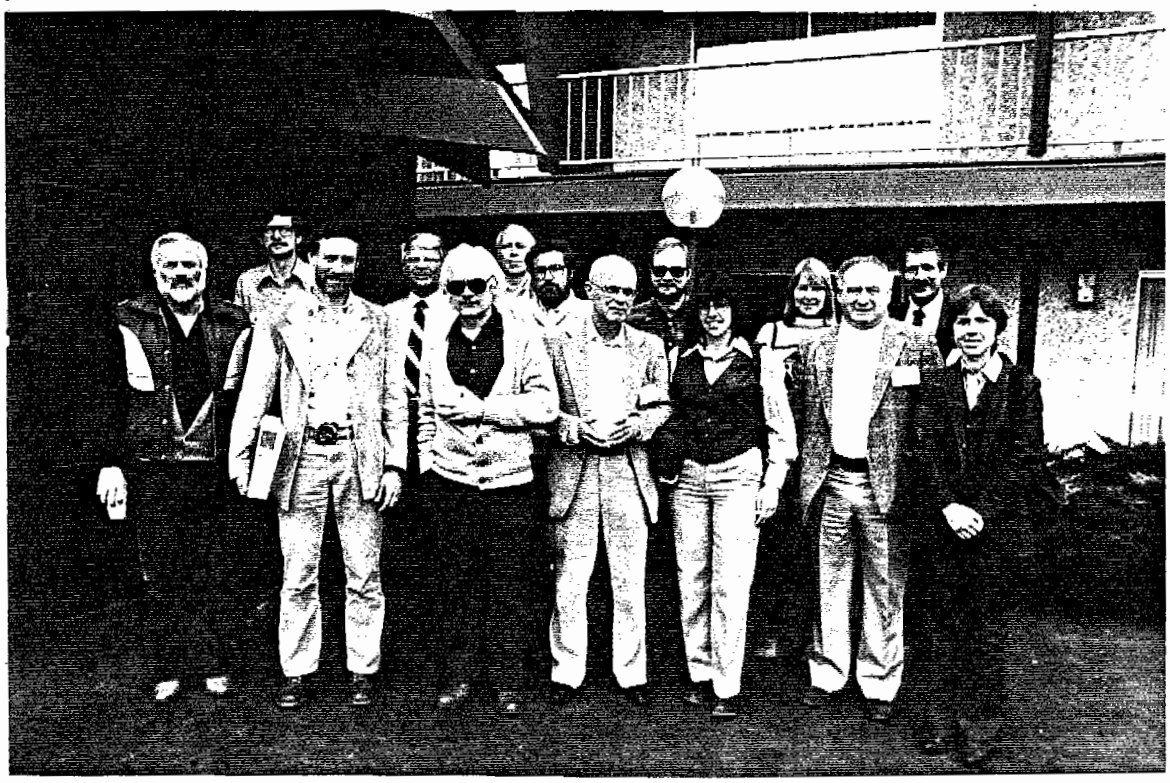
GROUP 4

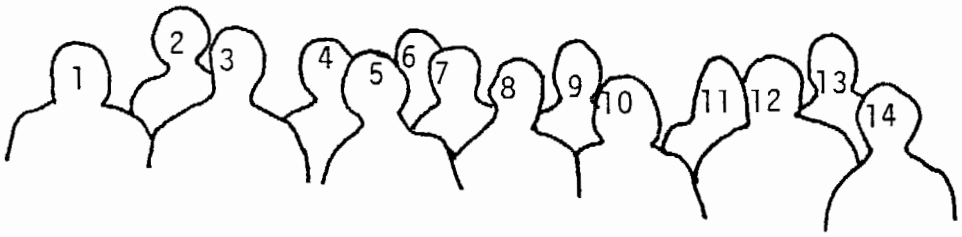
1. Leslie Cheng
2. Staffan Lindgren
3. William Kemp
4. Mike Wagner
5. Max McFadden
6. Ken Miller
7. Kathy Sheehan
8. bob Celaya
9. Bob Wolfe
10. Andy Eglitis
11.
12. Stuart Whitney
13. Anne Butterfield
14. Art Stock
15. Gary Pitman
16. Roger Ryan
17. Lonnie Sower
18. Sue McElderry
19. Ed Holston
20. Dave Perry
21. Bob Bridges
22. Dennis Warkentin
23. Don Kinn
24. Gene Lessard



GROUP 5

1. Steve Kohler
2. Marc Wiitala
3. Max Ollieu
4. Dan Twardus
5. Dale Kirkbridge
6. Jed Dewey
7. Tim McConnell
8. Michael Miller
9. John Borden
10. Bruce Hostetler
11. Bernie Raimo
12. Kurt Yandell
13. Ladd Livingston
14. Ralph Thier
15. Ronald Billings
16. Fred Stephen
17. Karl Stoszek
18. Scott Cameron
19. Dan Brassard
20. Al Chase
21. Don Dahlston





GROUP 6

1. Don CaHill
2. Dennis Ferguson
3. Clint Carlson
4. Bruce Roettgering
5. Bob Campbell
6. Gerry Lanier
7. Jim Byler
8. John Moser
9. David Schultz
10. Alison Hobbs
11. Elizabeth Principe
12. Doug Miller
13. Temple Bowen
14. Jackie Robertson

TECHNICAL PROGRAM

Thirty-third Annual Western Forest Insect Work Conference

Missoula, Montana

March 1-4, 1982

Monday, March 1

3:00 p.m.	Registration	
8:00 p.m.	Executive Committee Meeting	

Tuesday, March 2

8:00 a.m.	Registration	
8:30 a.m.	Initial Business Meeting and Conference Opening	
9:00 a.m.	KEYNOTE ADDRESS: Ross MacDonald	
10:15 a.m.	WORKSHOP 1:	
	1. Considerations for mountian pine beetle management.	Mark McGregor
	2. Use of computer models in pest management.	Ralph Johnson
	3. Developing silvicultural prescriptions using entomological inputs.	George Wilson
	4. Douglas-fir tussock moth: new technology.	Jed Dewey
	5. CANUSA: update.	Kathy Sheehan
12:00 Noon	LUNCH	

Tuesday, March 2, (Cont'd)

1:00 p.m. — DEBATE: The economics of forest insect management.

Moderator: Tom Bible

Panelists: Peter Berck
Doug Brodie
Tom Maher
Marc Wiitals

5:30 p.m. — 5-mile "Fun Run"

7:00 p.m. — Slide and photo salon, publications and gadget displays.

Wednesday, March 3

8:00 a.m. — PANEL 1: Silvicultural management for forest insects.

Moderator: Bob Naumann

Panelists: Mark McGregor
Clint Carlson
Robert Dennee

10:15 a.m. — WORKSHOP 2:

1. WFIWC: Past trends and future prospects. — Alan Berryman
2. Douglas-fir tussock moth: where are we? what next? — Ladd Livingston
3. Forest genetics and implications for insect management — Kareen Sturgeon
4. Hazard rating systems and their implementation. — Gene Amman
5. Management of insects other than "big bugs". — Les McMullen

12:00 Noon — LUNCH

Wednesday, March 3, (Cont'd)

1:00 p.m. — Local tours, discussion groups, recreation

5:00 p.m. — Wine and cheese mixer

8:00 p.m. — Guest Speaker: Grissly bear management. — Allen Christianson

Thursday, March 4

8:00 a.m. — WORKSHOP 3:

1. Current management strategies for spruce beetle. — Ken Gibson
2. Uses of biologicals in pest management. — Don Dahlsten
3. Uses of photography in forest entomology. — Bill Ciesla
4. Current management strategies for western spruce budworm. — Clint Carlson
5. Major economic issues for the 1980's. — Con Schallau

10:15 a.m. — Final Business Meeting

10:45 a.m. — PANEL 2: Developing a pest management system for the western pine shootborer.

Moderator: Karel Stoszek

Panelists:

12:00 Noon — LUNCH

1:00 p.m. — PANEL 3: Roles in the interdisciplinary approach to land management planning.

Moderator: Dale Bosworth

Panelists:

Thursday, March 4, (Cont'd)

3:15 p.m.

WORKSHOP 4:

1.	Pest management philosophies	Peter Hall
2.	B.t.: update and future use.	Dayle Bennett
3.	"Big bug" programs: status, future, etc.	Paul Buffam
4.	Evaluating large-scale direct supression projects.	Bill Wulf
5.	Host susceptibility/insect interaction.	Evan Nebeker

ADJOURN

Speakers, Moderators and Panelists - Affiliations

CANADIAN FORESTRY SERVICE
- Hall, Peter; Victoria, BC
- MacDonald, Ross; Victoria, BC
- McMullen, Les; Victoria, BC

IDAHO DEPARTMENT OF LANDS
- Livingston, Ladd; Coeur d'Alene, ID

LINFIELD COLLEGE
- Sturgeon, Kareen; McMinnville, OR

MISSISSIPPI STATE UNIVERSITY
- Nebeker, Evan; Mississippi State, MS

NORTHWOOD PULP AND TIMBER, LTD.
- Maher, Tom; Prince George, BC

OREGON STATE UNIVERSITY
- Bible, Tom; Corvallis, OR
- Brodie, Doug; Corvallis, OR

UNIVERSITY OF CALIFORNIA
- Berck, Peter; Berkeley, CA
- Dahlsten, Don; Berkeley, CA

UNIVERSITY OF IDAHO
- Stoszek, Karl; Moscow, ID

USDA, FOREST SERVICE
- Amman, Gene; Ogden,UT
- Bennett, Dayle; Albuquerque, NM
- Bosworth, Dale; Kalispell, MT
- Buffam, Paul; Portland, OR
- Carlson, Clint; Missoula, MT
- Christianson, Allen; Libby, MT
- Ciesla, Bill; Fort Collins, CO
- Dennee, Robert; Missoula, MT
- Dewey, Jed; Missoula, MT
- Gibson, Ken; Missoula, MT
- Johnson, Ralph; Missoula, MT
- McGregor, Mark; Missoula, MT
- Naumann, Bob; Missoula, MT
- Schallau, Con; Corvallis, OR
- Sheehan, Kathy; Portland, OR
- Wiitals, Marc; Portland, OR
- Wilson, George; Kalispell, MT
- Wulf, Bill; Missoula, MT

WASHINGTON STATE UNIVERSITY
- Berryman, Alan; Pullman, WA

THIRTY-THIRD WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Executive Committee Meeting
Missoula, MT, March 1, 1982

Chairperson Buffam called the meeting to order at 8:00 p.m.

Present were:

Paul Buffam, chairperson
Skeeter Werner, secretary-treasurer
Stu Whitney, councilor
Molly Stock, councilor
Ken Gibson, program co-chairperson
Mark McGregor, program co-chairperson
Scott Tunnock, local arrangements co-chairperson
John Dale, 1983 meeting representative

Absent were councilor John Laut. Minutes of the 1981 Executive Committee Meeting and the Treasurer's Report as of March 1, 1982 were read and approved.

Ken Gibson announced the only program change from the original plan was that Peter Hall's workshop was moved from Wednesday to Thursday afternoon.

Registration fees of $20 for regular members and $10 for students and regular members paying their own travel expenses were approved.

The high cost of publishing the proceedings was discussed since last years minimum bid for publishing 120 copies of the proceedings was $8.00 per copy. The proceedings were published by Forest Pest Management of Region 6 in Portland at no cost to the WFIWC.

Chairperson Buffam reported that Dick Washburn could not undertake the work conference historian position this year because of personal conflicts. He probably can begin working on the history of the WFIWC in late 1982.

The elected positions of chairperson, secretray-treasurer, and one councilor were to expire at the end of the 1982 meeting. Chairperson Buffam appointed Molly Stock to chair a nominating committee of herself, Stu Whitney, and Dave Fellin.

Stu Whitney noted that with the meeting in March and the Canadian Forestry Service fiscal year ending in March, it is important to get the meeting agenda, especially the program, out as early as possible to enable prospective meeting attendees to spend their year-end money wisely.

The Executive Committee noted that an invitation for the 1984 work conference needs to be called for at the 1982 initial business meeting.

John Dale reported the 1983 work conference meeting location is tentatively set for South Lake Tahoe but Santa Barbara is also a possible location. Program chairpersonship is still undecided and a decision on this position should be made before the end of this work conference.

The meeting adjourned at 9:00 p.m.

THIRTY-THIRD WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Initial Business Meeting
Missoula, MT, March 2, 1982

Chairperson Buffam called the meeting to order at 8:40 a.m. He welcomed members to Missoula and the famed "Big Sky" country, even though the sky was no where to be seen.

Minutes of the 1981 Final Business meeting and the Treasurer's Report were read and approved. The treasurer reported a balance of $621.75 at the beginning of the 1982 meeting.

Minutes of the 1982 Executive Committee Meeting held Monday night, March 1, 1982 were read.

John Dale reported on the prospects of holding the 1983 WFIWC at South Lake Tahoe but also pointed out that Santa Barbara might also be considered because of recent reports of gypsy moth infestation which may be of some professional interest.

Chairperson Buffam asked for location nominations for the 1984 meeting. Bruce Hostetler invited the conference to the Pacific Northwest region. Molly Stock seconded Hostetler's nomination but suggested the conference also consider the Idaho-Eastern WAshington areas as part of the Pacific Northwest region.

Buffam suggested that conferees from these areas meet and decide on a definite meeting place by the 1983 work conference.

Buffam reported that he contacted Dick Washburn regarding his role as historian of the WFIWC. Washburn has been vacationing in the South Pacific and will consider the job sometime in the spring of 1982.

Chairperson Buffam asked for a moment of silence in remembrance of members who passed away during the past year. Those members were Phil Johnson, Ken Hughes and Don Gordon.

Karl Stoszek presented a written report to the work conference by Torgy Torgersen chairperson of the Common Names Committee. Proposed insect common names are: western conifer seed bug for Leptoglossus occidentalis Heidemann; ponderosa pine needle miner for Coleotechnites ponderosae Hodges and Stevens; and western budworm for Choristoneura occidentalis. The report of the common names committee will be posed in the registration area for review by conference members. Karl Stoszek announced his resignation from the common names committee. The vacant seat on the committee should be filled at the final 1982 business meeting.

Kareen Sturgeon, a member of last years Ethical Awards Committee, awared a beautiful enscribed plague to last years most mischievous conference member. A quite distinguished-looking gentleman from Texas reluctantly accepted the award. After a 5-minute acceptance speech, it was hard to get Tom Payne off center stage.

Steve Wood announced his newly released book would be on sale to individual members at the conference for $40; otherwise the cost was $60 to institutions and those not attending the conference. Steve is to be commended for his effort in producing this prized reference book on bark beetles.

Chairperson Buffam stressed the need for immediate ideas on future publication of the WFIWC proceedings because of the rising costs involved. He thought that the 1982 proceedings could again be published by Forest Pest Management, Region 6.

Scott Tunnock made several announcements regarding local arrangements.

Max McFadden of the USFS, WO announced than an informal discussion on the 1983 budget for Forest Insect and Disease Research would be held Tuesday at 8:00 p.m. in the V.I.P. room of the Valley Red Lion Motel.

There being no further business the meeting, was adjourned at 9:15 a.m.

TREASURER'S REPORT

Thirty-third Western Forest Insect Work Conference

Missoula, MT, March 1, 1982

Balance on hand March 3, 1981:	(+)	$ 897.38 (CAN)
Income from Banff Conference:		
Registration (120)	(+)	$2,522.86 (CAN)
	(+)	$ 40.00 (US)
Sale of 1980 Proceedings	(+)	$ 20.00 (CAN)
Expenses of Banff Conference:		
Banff Centre Secretary	(-)	$ 45.00 (CAN)
Donation to Dinner Speaker (Canadians to Mt. Everest)	(-)	$ 100.00 (CAN)
Balance on hand March 5, 1981:		$3,295.24 (CAN)
		$ 224.71 (US)
Conversion to US Funds		$3,056.30 (US)

Additional Expenses of Banff Conference:		
Banff Centre Facility Use	(-)	$1,504.90
Banff Centre Gratuity Fund	(-)	$ 100.00
U.B.C. Faculty of Forestry (Program planning Expenses)	(-)	$ 508.91
Checks for Checking Account	(-)	$ 6.08
Interest Income:		
Checking Account	(+)	$ 50.24
Savings Account	(+)	$ .30
Balance December 31, 1981		$ 986.95

Expenses of Missoula Conference:		
Receipt Book	(-)	$ 9.66
Program Printing	(-)	$ 94.59
Souvenir Hats	(-)	$ 206.00
Name Tags	(-)	$ 54.95
Balance on hand March 1, 1982		$ 621.75

KEYNOTE ADDRESS

INSECT MANAGEMENT AS AN INTEGRAL PART OF FOREST MANAGEMENT

D. Ross Macdonald
Regional Director, Pacific and Yukon
Canadian Forestry Service
Victoria, B. C.

When Mark MacGregor phoned to ask me to give the keynote talk I defended myself by reminding him that a Canadian Forestry Service executive had given the keynote at Banff last year but he wouldn't let me off the hook that easily. I would like to remind you that Jim Cayford outlined a number of challenges for facing forest entomologists in the '80s. Not the least of these was the need for the forest entomologists and their associates to get into the mainstream of forestry. He believes that too many have hung back. They do not belong to the professional forestry associations - the CIF in Canada, the SAF in the US. They are content with their entomological societies and similar groups which satisfy the demands of their narrow discipline in science. I hope that procrastination is changing and at least trust that the CFS scientists have already committed themselves to joining the CIF. The rest of my sermon is going to explore why it is important to make the link.

My present position has forced me to stand back several paces from the details of forest entomology. For the past five years I've become more involved assessing and developing new programs, advocating policies and fighting the survival of the organization war. Lately there has been a lot of effort devoted to planning work that will be more responsive to the needs of the 80s and 90s. The comments that I am going to make this morning reflect some of the frustration and even the sense of accomplishment that I believe is happening in forestry.

Every year we talk a lot about how awful it is, we issue 'Aint it Awful' reports on budworm and mountain pine beetle, larch casebearer and whatever. We are encouraged when the papers run something from our press releases and we despair amongst ourselves when we cannot persuade the managers to take early action. One of our real problems is that we are a Catch -22 discipline. If we were really successful there wouldn't be any insect outbreaks. We would be able to advise on preventive action all the time rather than devoting most of our resources to the 'aint it awful' situations that are really beyond our puny capabilities and are truly in the hands of nature and time to resolve.

The spruce budworm, mountain pine beetle and gypsy moth catastrophies are enough to make one wonder if pest management has any relation to forest management at all. It is obviously related to political entomology but that is another course on the curriculum. But we do have some remarkable progress today too. For example, when the Baskerville Task Force on the budworm in New Brunswick reported on the status of research in 1976 they stated that there was no real alternative to chemical insecticides and they were right! They stated that the biological insecticide Bt "is not considered an adequate substitute for chemical insecticides

in large-scale crop protection". All who have been associated with Bt experiments would probably agree with that assessment. The experiences have been frustrating. It would work well one time and be a bust the next. There always seemed to be some hope, however, and there were several believers. So in 1978 we decided to take advantage of the spirit of cooperation that existed (fostered in part by the communication encouraged by the CANUSA program and the Eastern Spruce Budworm Council). We invited agencies using or testing Bt to participate in a minimal experimental standards program. The CFS provided a coordinator, Ozzie Morris, and most of the experiments and operations collected enough data in a similar manner so that the results could be compared and even integrated with a reasonable amount of confidence. The agencies kept collaborating and benefitting from the experience. A few weeks ago George Green, Director, FPMI, reported to us that Bt is now being used operationally on a large scale. It will not replace the chemicals everywhere but the forest entomologist can now advocate some site-specific prescriptions with more confidence than ever before.

There is a similar encouraging story in the West. You will recall that the Douglas fir tussock moth 'Big Bug' program of a few years ago produced a number of contributions to science, not the least of which were the pheromone and the virus. The tussock moth didn't recognize the schedule imposed by Congress and was indiscrete enough to collapse in Oregon and Washington before the funding was scheduled to run out. Fortunately, and in a spirit of international cooperation, the B. C. tussock moth population came to the rescue by building up (We always have a lag period with US fashions, it helps us to get through some of the more bizarre ones more rapidly). A good cooperative program developed between the US and Canadian scientists with several people finishing off the DFTM work in the late 70s in BC against real live insects! In 1980 Roy Shepherd was able to detect the population increasing again through the use of the pheromone. The virus was introduced this past summer in a very successful trial conducted cooperatively by the B. C. Ministry of Forests and the CFS. The BC Ministry will be carrying on further developmental trials this summer while Shepherd and Otvos will follow up the first experiment providing the information necessary for registration. I understand that you will hear more about this at one of the workshops, so I'll leave it by saying that again the forest entomologist is gaining another specific tool for site specific management.

The story in the West is not complete without some discussion of the mountain pine beetle. There'll be a lot of that in the workshop to follow but I should mention that the mpb also leads us to a major cooperative development in forest management. As you know, mpb is devastating vast areas throughout the West. Forest management agencies are responding to the challenges that have been building up over the past decade. British Columbia has announced that it will spend over $11 million this year and next addressing the beetle problem. Much of this will be for access roads and will probably result in more salvage logging than in initial attack but that is the fact of life given the state of forest management and the economy today. Alberta is engaged in a vigorous initial attack program, spending between one and two million dollars annually to prevent the development of outbreaks in the central foothills forests. A new interagency committee has been

formed to deal with the problem along the Alberta - B.C. border. Members include the B. C. and Alberta forest services, Parks Canada and the Canadian Forestry Service. A concerted effort is being undertaken against spot infestations on the front of the outbreak in the Rocky Mountain Trench to prevent the beetle from moving across the Divide into Alberta. This includes the cutting and burning of several small pockets of infested trees in Kootenay National Park. I think that it is worthwhile to acknowledge the cooperation that Parks Canada is willing to provide in this case. It is undertaking a control action within the national park with the agreement that the neighbouring agencies are taking action as well.

The magnitude of the beetle problem has reached the stage of becoming a focus for international cooperation. A meeting was held at Fairmont Hot Springs, B. C. in November to review the situation for senior officials. Les Reed, the Assistant Deputy Minister, Forestry, CFS, and Max Peterson, the Chief, USFS, met with the Chief Foresters of B. C. and Alberta and senior State foresters, industry and union representatives, academics and scientists. The meeting served as an information session for the executives and as a sounding board for discussions on the development of improved cooperation and collaboration between Canada and the U. S. federal, state and provincial forestry agencies. There is a major move under way to have a blanket Memorandum of Understanding for cooperation in forestry research and operations between Canada and the U.S. The mpb will be the subject of a sub-agreement, similar to the CANUSA budworm agreement.

All of this bureaucratic jockeying may seem a bit far removed from your theme. But I would point out to you that the major actors in forest management in both countries are having to spend more and more time on pest-related problems. Government, industry and union executives are recognizing the limitations on the wood supply; they are acknowledging that there is a crisis in regeneration and a problem in the backlog of understocked forest. They recognize that the existing forest must be protected to a much greater degree than before and they are expecting that the scientists will tell the foresters how to do it. So I return to my initial remarks. Pest management is, of course, an integral part of forest management and it is up to the forest entomologist and his associates to work closely with the silviculturist, the management forester, the planner and the whole array of other disciplines that contribute to the well being of our forests. I must return to Jim Cayford's admonition last year. It is not enough to leave the communication of pest management information to the tech transfer people or the survey officers. It is important for everyone associated with this work to become participants and to take their place with the forestry profession as a whole to ensure that pest management is an integral part of forest management.

Thank you.

PANEL: THE ECONOMICS OF FOREST INSECT MANAGEMENT
Moderator: Tom Bible
Panelists: Peter Berck, Doug Brodie, Tom Maher, Marc, Wiitala

The panel was formed to present economic issues related to forest insect management in contexts beyond those found in traditional EIS's and EA's. An entomologist is usually not directly involved with preparation of cost/benefit analyses for forest insect problems except to the extent that they are asked for information to be used in an analysis. Consequently, entomologists are often unaware of how their work supports economic analyses of forest insect problems currently, and, more importantly, are also often unaware of potentially important contributions that they can make in an era of changing focus for forest policy. Compounding the problem is the fact that economists, forest planners, and other decision-makers are only vaguely aware of some of the contributions that can be made by entomologists and entomological research to forest planning and policy and are completely unaware of many other contributions that could be made.

Most of the Conference participants are familiar with the traditional cost/benefit approachs that have been conducted on a stand by stand basis to evaluate forest insect problems in the past. The scenario is usually close to the following: Insects damage, and perhaps kill trees; at the least, tree growth loss is observed. Tree losses are equated to dollar losses by pricing volume reductions attributable to insects. Finally, dollar losses are discounted to present values and those values are compared to current suppression or control costs. If benefits (losses to be avoided) exceed costs, a control program is merited.

However, as we move into an era that is expected to be increasingly dominated by large scale, forest-wide planning and tightening budget constraints, entomologists can ensure a fair share of attention by being aware that they can make contributions to forest management far beyond the contributions made in their current roles. Whether we like it or not, current policy directions seem to imply that entomologists and other researchers will, in increasing measure, be asked to make their own cases for research support and an important first step in that direction would be to discover how entomological information is used in management decision-making and what additional information would be used if it were available.

The panel members each addressed a different but related problem area where entomologists can make significant contributions to forest management in the environment that is now evolving for forest decision-making. The presentations were developed to explain the economic criteria for current decision-making and to suggest how insect damage could affect that decision-making process. Four problem areas that have been identified as important by forest managers are: Evaluation of the long and short term benefits of insect survey programs; a priori evaluation of stand level insect impacts in the context of a harvest schedule; a priori evaluation of forest-wide insect impacts in the context of a forest plan; and, information that could be provided by entomologists and entomological research to forest managers dealing with current insect outbreaks. Those issues were addressed respectively by Tom Maher, Doug Brodie, Peter Berck, and Marc Wiitala.

Tom Maher, Northwood Pulp and Timber Ltd., Prince George, B.C.

Insect monitoring and early detection systems have value to management in terms of the value of information obtained from monitoring insects. The value of information is expressed as the expected losses that could be avoided by timely action taken to control insect populations early in their population cycle. The spruce bark beetle was used as an example to examine this important issue as it impacts timber production in British Columbia.

The spruce bark beetle was chosen because Northwood Pulp and Timber has been involved with bark beetle problems and early detection programs over the past several years in two regions of British Columbia. In one region, early detection of beetle populations allowed early control actions and tree losses were held down. In another comparable region, little detection activity was undertaken and significant timber losses occurred because of bark beetle populations in that region. In the first area, timber losses were limited to 1.5 million cubic metres of wood by early intervention while in the second area, 12 million cubic metres of wood were lost. Those latter losses occurred between the time that early detection would have picked up beetle problems had detection been implemented and the time that a control program was actually implemented after beetles were detected with other means. The example provides a clear indication of the value of monitoring information and early detection systems for one insect.

In Northwood's operating area, a conservative estimate of the benefits and costs of early detection for the bark beetle program indicated that benefits exceeded costs of the program by a ratio of 150 to 1. However, early detection should be a long run program and cost/benefit ratios chould not be the only basis for justification of annual funding for insect detection sampling.

Doug Brodie, Department of Forest Management, Oregon State University.

With respect to stand level insect damage, the principal issue is that insect damage at one point in time can be felt as economic impacts at other points of time in the rotation. For example, losses or expected losses due to insects can alter the optimal timing of harvest strategies such as thinnings over time with subsequent changes in stand values. Value changes over an entire rotation may differ significantly from losses calculated traditionally by simply multiplying expected volume loss at the time it occurs by a "spot" price and discounting the result to its present value.

In that context, certain areas of entomological research have great potential value to forest managers. Research that assesses stand risk to insect outbreaks or allows managers to assess the duration, timing and intensity of outbreaks leading to timber losses at a point in time would be important to forest managers.

Peter Berck, Department of Agricultural and Resource Economics, University of California, Berkeley.

The forest-wide impacts of insect damage is a direct function of the constraints imposed by regulations and policy that determine forest harvest levels over time. Economic impacts of insect damage at one point in time for a single stand or acreage class can appear at other points in time and in other acreage classes depending upon the constraints imposed on forest-wide harvest schedules. In the context of forest planning, probable or expected losses attributable to insects several decades in the future can necessitate actions now that have costs and benefits that are quite different from the traditionally calculated net present value of insect damage expected in the future.

Relocating economic of insect losses to different times and acreages are especially likely when forests are managed for even flow and allowable harvest levels that are tied to forest-wide timber growth. That fact is important to entomologists because it casts the notion of economic impacts of insects in a new context. Economic losses can be significantly altered when losses are "brought forward" by allowable cut effects and even flow constraints.

Marc Wiitals, U.S.D.A. Forest Service, R.O. Area Planning and Development, Portland, Oregon.

When an outbreak is developing or in progress and information is required to support EA and EIS development, access to published and unpublished entomological research results is an important factor in timely control programs. But "access" means more than simple availability of potential research to managers. Access implies that economists and managers not necessarily trained in entomology can identify required data quickly without having to personally contact the researchers who conducted the work.

Data on population dynamics, expected yield losses, and insect outbreak durations are particularly important in this context. Stand recovery potential is also important and directly related to the possibility of other types of insect outbreaks following an existing outbreak. Dispersal information is also important to managers who are developing EA's and EIS's. Managers recognize that all of the required information is likely "somewhere in the literature", but if some of the more operational aspects of research were clearly identified, important decision-making information would be easier to find.

Panel: SILVICULTURAL MANAGEMENT FOR FOREST INSECTS
Moderator: John R. Naumann
Panelists: Mark D. McGregor, Clinton E. Carlson, Robert Dennee

Opening remarks recognized that forests and insects have evolved together over time. Insects will continue as part of forest ecosystems and silvicultural practice will continue. This practice influences composition of tree species, stand densities and structures, tree sizes and growth rates. As a result, insect populations are affected. While we know much about the theory of forest and insect interactions, we know less about the application of this theory to solve forest management problems. Forest entomologists and Foresters are cooperating to apply silvicultural control methods. This topic will be discussed by the panel on the basis of mountain pine beetle and western spruce budworm management currently being used in Montana.

Mark McGregor pointed out that direct control methods historically used to reduce lodgepole pine losses to mountain pine beetle have not been lastingly successful. Silvicultural practices offer the most promise for reducing loss. Attention is focused on the forest rather than the beetle. The goal should be to alter the forest to reduce losses while creating conditions compatible with overall management. A key factor in developing any prescription is setting objectives. Partial cutting offers promise of meeting many objectives in the short term. Partial cutting strategies in mature and overmature lodgepole pine are not intended to regenerate the stand or be a long term solution. But these strategies are prooving to be a management alternative to use in conjunction with regeneration and salvage cutting to bring about a total desired effect over a larger area in the long term.

Clint Carlson reported on work he is doing through the Forestry Sciences Laboratory in Missoula to define the effect of western spruce budworm on probability of stocking, defoliation on established regeneration and conditions that can predispose stands to budworm attack. It was found that western spruce budworm reduces probability of stocking on drier sites with limited diversity of conifer species. However, the insect appears to have only a nominal feeding effect on established regeneration. Mature stands on dry, low-elevation sites with steep slopes suffer greatest radial increment impact. Silvicultural prescriptions tailored to the site will alleviate most WSBW impact to young stands. Optimum species diversity should be called for and intolerant species should be favored. Avoid conditions that lead to overstocking. Also, uneven-aged strategies appear to be less favorable to WSBW than even-aged. Over a drainage, a good mosaic of age-classes and species distribution will decrease stand susceptibility to tolerable levels.

Bob Dennee addressed management of stands for both the mountain pine beetle and the western spruce budworm from a forester's viewpoint. He stated that the application of research results relative to insect management is made primarily through the silvicultural prescription process. The silviculturist must think through future consequences of proposed actions. Highest priority for stand treatment is given where specific land management and resource objectives are best met. Pro-

grammatic environmental assessments of epidemics and risk rating systems are important tools used by the silviculturist. Also considered are growth rates, presence of the insect, fuel loading and hazard and economic value.

Much reliance is placed on clearcutting in areas affected by the mountain pine beetle. Sanitation and salvage cutting must be used with caution to avoid long-term problems. Partial cutting can be applied on a limited basis.

Management for budworm has taken a backseat to management for mountain pine beetle. Silviculturists work with the concept that stand susceptibility depends on stand attributes which the silviculturist can manipulate. Salvage cutting is of limited applicability because low volumes and high logging costs are usually incurred. A more viable approach is reducing stand vulnerability by changing stand structure, species composition and increasing stand vigor. The use of risk rating systems in the timber sale planning process would help to increase the level of management against this insect.

WORKSHOP: CONSIDERATIONS FOR MOUNTAIN PINE BEETLE MANAGEMENT

Moderator: Mark D. McGregor

Participants: Tom Puchlerz, Larry Keown, Pat Graham, Robert Dennee, Ron Brohman

Wildlife Concerns

The Hebgen Lake RD, Gallatin NF has experienced a MPB epidemic since 1969. Some primary issues concerning management of affected stands revolved around the habitat requirements of elk and grizzly bear. The recreational values of elk as well as general biological needs are important. Ability of analysis areas to provide (1) uniform harvest rates of elk, (2) high percent of mature bull harvest, and (3) high elk retention during hunting season are related to hiding cover and open road density. Utilization of hunting season regulation is an important factor if mitigation measures will not allow managers to attain recreational goals. Grizzly bear management in regards to cover and open road density are important concerns where management can reduce bear mortality. Management options are less flexible than with elk due to the current depressed bear population.

Fire Concerns

Encouraging foresters to manage green LPP stands rather than dead timber stands reduces fuel building and catastrophic fires. Such variables as degree of infestation, stand characteristics, resulting fuel load and fire behavior, fire occurrence, and location must be accounted for. These factors were considered in a model that predicts fuel load, fire behavior, and probabilities of fire occurrence. Computer application of Rothermel's fire spread model was used in assessing fire behavior. Fuel loadings were calculated manually using expected mortality and the Handbook for Predicting Slash Weight of Western Conifers by Brown et al. (1977). Following assessment completion, treatment opportunities are identified based on fire occurrence, behavior, fuel loading, values at risk, and land management allocation.

Doing nothing and use of prescribed fire are options for classified wilderness. Outside classified wilderness, options include doing nothing, timber harvest (sanitation/salvage), stand management, utilization (fuelwood), and fuel treatment. Direct fuel treatment includes prescribed burning, removal alterations etc.; indirect treatments include fuelbreaks, firebreaks, and increased protection.

Fisheries Concerns

The implications of management of MPB and spruce beetle infested stands on long-range forest planning has cumulative impact on the fisheries resource. Spawning populations are smaller in size and more concentrated in specific stream reaches, and occurs in areas of low gradient, medium size streams characterized by aggrading bed material. Spawning areas are sensitive to changes in peak water yield resulting in bank stabilization problems. Low gradient areas are more sensitive to accumula-

tion of sediment, particularly over winter when eggs are in the gravel. Management which accommodates both timber and trout must (1) identify critical habitat parameters; (2) address cumulative disturbances in a drainage; (3) establish thresholds for management; and (4) continue monitoring activities and habitat parameters. The problem in implementation is compounded by trying to accommodate the short-term crisis management associated with insect-infested timber. Management decisions should identify (1) realistic annual harvest quotas; (2) critical habitat areas which require intensive management (riparian vegetation); and (3) developing and using tools to temporarily control or direct the spread of insects to give forest managers more flexibility to design timber sales compatible with long-term management plans.

Timber Management Concerns

The application of research results relative to insect management is made through the silvicultural prescription process. These prescriptions translate land management objectives into sound treatments that are implemented within the timber management program. Prescriptions develop treatment (technically correct and environmentally sound) alternatives; and give direction for any treatment or activity in a forest stand, and directs three primary activities: (1) reforestation, (2) stand improvement, and (3) commercial harvest. Timber sale planning is applied on a compartment basis involving an analysis of all affected resources. Inventories are completed and resource objectives established for the compartment. The basic timber resource inventory is the stand examination. Stand examination information includes a number of individual tree and stand parameters including species, age, stocking levels, growth rates and stand structure. Site information includes habitat type, soils observation, elevation, aspect and slope, and information relative to wildlife use and fuel loading, lodgepole pine cone serotiny, and insect and disease damage status. These data are necessary for the silviculturist's diagnosis and prescription.

Alternative silvicultural treatments to support management objectives are developed on a stand basis. Options include no treatment, regenerate with a seed tree, clearcut, or shelterwood method, thin the stand, selection harvest, sanitation or salvage harvest, or an overstory removal release treatment.

Stands are prioritized based on: (1) direction provided in a mountain pine beetle program EA; (2) risk rating stands in conjunction with stand examination process. Procedures used are based upon Amman et al. INT-36. Variables are age, d.b.h., and elevation. Percent of lodgepole pine BA is also incorporated. The newest information concerning habitat type groups has tremendous potential for application. McGregor, using Cole's MBP model found significant differences in tree and volume losses and duration of MPB epidemic activity within stands by habitat type or habitat type group. This information will be a valuable guide to prioritize harvest within groups of high hazard stands. The silviculturist will

know what risks are inherent in the future, say 10-year period, given the option of deferring treatment through that period.

A third tool used to prioritize stands for treatment is a localized stand priority system based on timber inventory data within a compartment. A formula developed (on the Bozeman Gallatin Ranger District) includes five factors: (a) growth rates, actual vs. potential, (b) mountain pine beetle risk rating, (c) insects and diseases present, (d) fuel loading and hazard, (e) economic value as expressed through average volume. These factors are tempered by our ability to access each stand and the technical feasibility of harvesting.

Clearcutting, one of the prime treatments in mature LPP stands, challenges are in properly scheduling cuts, designing their size, shape, and juxtaposition. The objective is to build resistance to future epidemics by creating diverse, mosaic patterns of size and age classes. Clearcuts must consider protection of wildlife, visual, recreation, and other values.

Salvage or a combination of sanitation/salvage are other treatments applied to reduce losses to MPB. Salvage treatment has created numerous long-term problems in some stands. Salvage works best in well-stocked stands with relatively minor components of host species, is generally confined to operable ground with access in place, and is applied in the early stages of the epidemic and in stands that are immature or in the earlier stages of maturity. Sometimes it is better to defer treatment than to apply a compromise treatment that does not satisfy resource objectives.

Mark McGregor discussed the d.b.h. limit and basal area cutting concept as a management option in susceptible LPP stands. The concept defers stand regeneration by reducing susceptibility in capturing the present mortality. Strategies are somewhat limited although they have been tested at Hebgen Lake, Squaw Creek, Yaak District, and on the Lolo NF. The procedure is to commercially thin mature and overmature LPP stands. It is a short-term measure, not designed as a long-term solution. It results in some degree of beetle-proofing and individual tree growth response. It can reduce stocking levels, increase windthrow hazard in some stands, and can decrease overall stand growth. It also results in some stand damage through mechanized skidding and can increase fuel loadings. It works best in stands with (1) low amounts of present mortality, (2) relatively high vigor, (3) mixed species, including some nonhost species, with high stocking levels so the residual stand can be managed. It should not be applied on steep terrain that cannot be conventionally logged, or in areas with high windthrow hazard.

Applications In Forest Planning

Coefficients were developed to adjust the Helena NF timber yield tables. Timber yield tables were adjusted for MPB by sorting stands as to predominant species, either LPP or mixed conifer. To obtain loss esti-

mates (tree and cubic foot volume) over infestation time, tree data were subject to analysis using Walt Cole's MPB model, analysis of variance, then graphed to show LPP mortality by habitat type over time. The model estimates tree and cu. ft. volume loss to MPB/habitat type in stands over a 10-year period.

For land management planning (land use allocation and the scheduling of management activities), the Forest Service currently uses FORPLAN, a linear programing model. In the FORPLAN model, management activities and associated outputs, costs, and environmental effects are made available for selection by the linear program by means of prescriptions for analysis areas. MPB will affect all parts of susceptible analysis areas, with the resulting mortality spread over two decades.

The procedure used was to adjust existing yield tables by the appropriate coefficients from Cole's model for each H.T. group for every analysis area. Regenerated stands were not adjusted because management should be able to prevent MPB outbreaks or keep them at a minimum in regenerated stands for a longer period of time.

WORKSHOP: USE OF COMPUTER MODELS IN PEST MANAGEMENT
Moderator: Ralph R. Johnson
Participants: Ron Brohman and Nicholas Crookston

Nicholas Crookston provided the following overview of the Stand Prognosis model and its insect extensions:

The Prognosis model may be used to predict the outcome of applying various management regimes to mixed conifer stands in the inland northwest United States. The model has been modified to explicitly represent the population dynamics of mountain pine beetle and Douglas-fir tussock moth. The CANUSA/West Spruce Budworms Program is supporting the development of a western spruce budworms population dynamics model and its linkage to the Prognosis model. The combined Prognosis/forest insect models explicitly account for insect caused damage and the associated impact on mortality rates, height and diameter growth, and top kill. Crookston suggests that for more information on Prognosis, you contact Dr. Albert R. Stage, Forestry Sciences Laboratory, 1221 South Main, Moscow, Idaho 83843.

Ron Brohman, a timber planner, presented the timber volume table methodology used on the Helena National Forest. Ron illustrated how the Forest adjusted the volume tables for the effect of mountain pine beetle. As one key step, the Northern Region's Pest Management Staff utilized a model developed by Walter Cole. Cole's model adjusted stand tables for expected losses due to mountain pine beetle.

Ralph Johnson discussed how timber volume losses are being calculated for a western spruce budworm infestation in Idaho. This loss assessment is being conducted by Ron Beveridge of the Intermountain Region of the USDA Forest Service and uses the Prognosis model in conjunction with tree growth measurements before and after budworm defoliation.

WORKSHOP: DEVELOPING SILVICULTURAL PRESCRIPTIONS USING ENTOMOLOGICAL INPUTS

Moderator: George R. Wilson

Participants: John Naumann, John Joy, Jim Vandenburg, Steve Kohler

There was considerable interest in the topic as the workshop was attended by 55 people.

John Naumann set the stage by briefly reviewing the overall development of a Silvicultural Prescription. Land management objectives and stand exam data are the starting point for silvicultural prescriptions. Insect and disease considerations always affect the silvicultural decision. Quantitative information is required to support the need to treat an area. The diagnosis step uses information about the site and the existing stand to define the need for cutting. Rather than starting with preconceived ideas about cutting, the silviculturist thinks about those forest conditions and stand targets that will benefit all allocated resources on the site. These conditions are described with stand attributes like species composition, stand densities and stand structures. The detailed prescription documents each action and the specifications needed to carry the action to the ground. The detailed prescription is written to insure correct implementation of the prescribed treatment. Most silvicultural prescriptions depend on others for their execution and directions must be clear and precise. The results of accurate diagnosis and prescription is a stand treatment that will meet objectives of resource management and develop stand conditions that are reasonably safe from damaging agents.

John Joy discussed the topic from the east-side management perspective. East-side Montana Forests have drier sites, are less productive and receive less financing than Western Montana Forests. Because of lower budgets, fewer people are available to write silvicultural prescriptions. Tree species throughout most east-side forests consist of Pinus contorta and/or Pseudotsuga menziesii. Currently there are scattered infestations of Dendroctonus ponderosae in the Pinus contorta on some forests. Choreestoneura occidentalis is also infesting some Pseudotsuga menziesii stands. Entomological input for silvicultural prescriptions and stand management is from a centralized group in the U.S. Forest Service Regional Office in Missoula, Montana. They conduct aerial surveys, provide on the ground assistance as requested, and develop computer programs that model insect problems.

Jim Vandenburg reviewed the development of an environmental assessment report which was prepared and used in deriving an action plan to combat the Dendroctonus ponderosae infestation on the Flathead National Forest. Seven alternatives were identified and an evaluation completed to assess the impacts and strategy. The preferred alternative provided land management decisions so the silviculturist could prepare a detailed prescription for its execution.

Steve Kohler discussed his working relationship with State Service Foresters. Private landowners have access to silvicultural prescriptions using entomological input through management plans. These plans are developed by Service Foresters at the request of the landowner. The Service Forester receives training in basic recognition and reporting of pest problems. Advanced training is provided for the management of important specific pests such as Dendroctonus ponderosae. State Forest Entomologists are available to provide assistance for Service Foresters.

WORKSHOP: DOUGLAS-FIR TUSSOCK MOTH: NEW TECHNOLOGY
Moderator: Jed Dewey
Participants: Karel Stoszek, Dan Twardus, Dennis May

In addition to Jed Dewey, (U.S.F.S., Missoula, MT), discussion leaders included Karel Stoszek, (Univ. of Idaho, Moscow, ID), Dan Twardus (U.S. F.S., Portland, OR), and Dennis May (Univ. of Idaho, Moscow, ID). About 20 members were in attendance and joined in discussion of many tussock moth related subjects.

Jed Dewey introduced the subject and discussed in general terms a Douglas-fir tussock moth management system. This consists of (1) a risk rating system; (2) a detection/population assessment system; (3) predictive models, i.e., probable effects of uncontrolled outbreaks, probable effects of selected treatments, probable socioeconomic impacts; (4) management alternatives, i.e., suppression and prevention.

Karel Stoszek led an in-depth discussion of Douglas-fir tussock moth risk rating, concentrating on when, where, why, and how this should be done. Site characteristics used to determine risk classification were stand age, depth of volcanic ash, percent grand fir and topographic position. Karel cautioned that a risk rating system can't be used throughout the West, or even a State, but must be tailored to fairly local areas. Uniform conditions are needed. Risk rating has much application but shouldn't be used too broadly.

Dan Twardus reviewed population assessment approaches that are available for the tussock moth and discussed when, where, why, and how the various systems could be used. These include (1) aerial survey of defoliation; (2) pheromone traps for male moth population assessment; (3) ground estimates of defoliation; (4) larval sampling i.e., lower crown beating for early instars, and midcrown sampling for estimating density; (5) egg mass sampling to classify the population, estimate density, assess trend and evaluate virus incidence.

Dennis May shared his experience with applying the model. Using actual stand data for the Palouse Ranger District Dennis has made stand projections with and without tussock moth, with a silvicultural treatment applied, and with a suppression effort using the nucleopolyhedrosis virus.

WORKSHOP: CANUSA UPDATE
Moderator: Kathy Sheehan
Participants: Nilima Srivastava, Al Stage, Bill Kemp, Kathy Sheehan

Results and current status of several CANUSA-West projects were presented and discussed at this workshop. Due to time limitations and scheduling conflicts, many other CANUSA-West sponsored projects were presented at other times during the conference.

Nilima Srivastava (PNW, Corvallis) began by describing sampling methods for western spruce budworm fourth instars that she has developed along with Roy Beckwith, Bob Campbell, and Torgy Torgerson. Douglas-firs and grand firs (primarily 7-14m) were sampled in northcentral Washington, central Idaho, eastern Oregon, and western Montana. Within trees, larvae occurred in a consistent vertical pattern, and density on midcrown terminal tips was a good predictor of whole branch density for each crown third. Using a foliage surface area ratio for the crown thirds, midcrown terminal tip density could be used to predict whole tree density. Equations derived from tips and branches of 7-14m trees sucessfully predicted density on whole branches of 20-30m trees. No differences were noted between hosts.

Al Stage (INT, Moscow) reviewed work on the effects of budworm feeding on host trees. Long range and indirect effects will be evaluated by analyses that use models of affected trees and stands. Separate (though coordinated) studies are measuring effects on: radial increment along the bole, height increment, and top-killing of pole-sized and larger trees; height increment of seedlings and saplings; and subsequent production of buds (vegetative and reproductive) and new foliage. Difficulties posed by long duration of defoliation are being overcome by relating growth and bud production to quantity and condition of remaining foliage rather than to proportion of missing foliage. Photographs of rated examples of defoliation are being prepared to help standardize field observations.

Bill Kemp (Univ. of Idaho, Moscow) summarized work done on the influence of weather on budworm. The importance of incorporating weather into any insect population dynamics work was discussed. Weather can be incorporated into population dynamics models through actual daily observations or through simulations. Daily minimum and maximum temperatures and precipitation may be calculated by a stochastic weather simulator (based on a modified program by Bruhn and others). Budworm and host phenology submodels were discussed. These models use daily maximum and minimum temperatures to predict synchrony between host and budworm and their developmental rates. Activities currently underway include verification of individual growth models and the simulation of developmental variability in both insect and host.

Kathy Sheehan (PNW, Portland) discussed the budworm population model, which will be used in conjunction with the Stand Prognosis Model of Stage and others to predict effects of defoliation by budworm on stand growth and yield. The model has two components: BWFLY, which covers budworms from emergence as adults to oviposition of eggs, and BWMOD, which follows them from egg hatch to adult emergence. Results from many research projects will be integrated into this model. A description of the combined stand prognosis/western spruce budworm model is available from the CANUSA-West office in Portland.

WORKSHOP: WFIWC - PAST TRENDS AND FUTURE PROSPECTS

Moderator: Alan Berryman

Participants: Stu Whitney, Walt Cole, Gary Pitman, Gene Lessard, some other layabouts who, I hope, will forgive me for forgetting their presence, and a proxy letter from Ron Stark

This workshop took place in the Red Lion bar on Wednesday afternoon. Discussion revolved around the original intent of WFIWC (founder member Cole had brought along a copy of the original constitution), and recent trends. From this discussion came a series of recommendations which we refer to the executive committee:

1. Reduce the formality of the conference; i.e., too many formal panels and workshops. Even the workshops, which should encourage free flowing ideas and discussion, are becoming forums for formal presentations. Perhaps slide projectors and overheads should be kept out of workshop rooms. Workshop participants should not be asked to present formal papers but just to take part in discussions.

2. Give the younger members more responsibility as workshop moderators and panelists. We old fogies thought that it was time for the old fogies to sit back and listen to some new ideas.

3. A better balance is needed between research and management issues. Since the Boise meeting there seems to have developed an imbalance towards the management (application) side.

4. Controversial issues should be discussed in open debate rather than one-sided panel discussions ("axe grinding and ox-goring" sessions - Ron Stark's phrases). The "debate" at the Missoula meeting was a completely one-sided "non-debate."

5. The chairman and council should play a more active role in program development, including decisions on the theme of the conference (perhaps alternative themes should be presented for vote at the final business meeting) and moderators, panelists, etc. They should also check the program before it is sent out, to make sure there is an equable balance between research and management issues and federal, state and university participants.

6. Wednesday afternoons should not be wasted in "play-time" activities. Those who want to ski, play golf, etc. can do so before the conference.

7. Ron Stark forwarded a resolution that we should elect two co-chairmen, one representing research, the other management; one drawn from the university sector, the other from public agencies. As Ron is now our chairman, and as he does represent both sectors, his wishes seems to have been miraculously fulfilled!

WORKSHOP: FOREST GENETICS AND IMPLICATIONS FOR INSECT MANAGEMENT
Moderator: Kareen Sturgeon
Participants: Jeff Mitton, Dave Neale, Gene Namkoong, Bill Libby

In the Northwest, we have begun to intensively manage our forests - to domesticate forest trees. As this domestication becomes more intense, the transfer of information between forest geneticist and forest entomologist will become more important.

Jeff Mitton (Univ. of Colorado) discussed the recent finding that forest trees harbor more genetic variation than any other group of plant or animal. Of the several mechanisms that could account for this, of most significance to forest entomologists was the role of parasites and predators. To the extent that predators and parasites prefer some genetic variants over others, they exert diversifying selection pressures on their hosts and thus contribute to the maintenance of high levels of genetic variation. Host genetic diversity, varying in space and time, is imperative for the continued coexistence between the host and its predators and parasites.

Dave Neale (Oregon State University) discussed the impact of various silvicultural regeneration systems on genetic diversity. He presented 3 examples where forest geneticists have been able to monitor the impact of the silvicultural system on the natural genetic diversity. Using allozyme loci as genetic markers, he showed that there was no reduction in either the number of alleles/locus (A) or in average heterozygosity (H) in either a Douglas-fir shelterwood or seed orchard, nor was there reduction in A between Monterey pines growing in their native range and in Australia. There was a 10% loss in H in the Australian pines. He concluded that there has been relatively little loss in diversity in the early stages of domestication and care must continue to be taken to prevent future losses.

Gene Namkoong (North Carolina State Univ.) discussed how forest geneticists can stabilize host-pathogen systems by genetic manipulation of the host and insect populations. He emphasized that genetic manipulation of the host alone (breeding for resistant genotypes) is not likely to effect control. Endemic populations of forest insects are often characterized by small, genetically variable sub-populations. Gene frequencies of insect populations could be manipulated to encourage this genetic structure; thus their endemism might be forced. The best strategy for controlling the density of forest insect populations will involve genetic manipulation of both insect and host tree populations.

Bill Libby (Univ. of Calif,. Berkeley) addressed the fact that as the domestication of forest trees in the NW continue, less regeneration will be accomplished using seeds and seedlings and more will be accomplished using clones. We must determine how many clones must be planted to provide an acceptable margin of safety from insect infestations. It has generally been assumed that the fewer clones planted, the greater the risks of an infestation. He presented data showing this is not always the case; in some cases, planting single clones is safer than planting several clones and just as safe as planting many clones. Not only are relatively few clones easier and more efficient for the nursery manager to handle, they are also more likely to reduce the probability that cross-adaptation to different clones will develop in narrowly adapted pests than is the use of a continuous distribution of genotypes.

WORKSHOP: HAZARD RATING SYSTEMS AND THEIR IMPLEMENTATION

Moderator: Gene Amman

Participants: Ron Billings, Gene Lessard, Pete Lorio, Mark McGregor, Evan Nebeker, Gary Pitman

Pete Lorio shared some ideas on the development and implementation of hazard rating systems. He advocated the use of data that the land manager usually collects in the process of making a stand examination or for other reasons. If a new technique is developed, based on data already being used for a multitude of other management purposes, it costs little or nothing to apply, and actually makes the overall management job easier. Foresters cannot afford to, or will not, apply significant time, effort, or expense to evaluate outbreak potential, particularly between outbreaks of sporadic insect pests such as bark beetles. Some systems may have to be complicated and require specialists gathering specialized data. However, the message is--keep it simple as possible and still get the job done.

Gene Lessard described the use of the Stevens-McCambridge-Edminster risk rating guide for mountain pine beetle in Black Hills ponderosa pine based on stand structure, average stand d.b.h., and stand BA/acre. Risk was considered to increase with increasing diameter, stand density, and in single storied stands. Lessard found losses to be related to soil type, and that the greatest risk occurred in the mid diameters. By considering these variables, he felt the risk rating system could be improved.

Mark McGregor showed that the hazard rating system of Amman and others based on elevation-latitude, stand d.b.h., and stand age for mountain pine beetle in lodgepole pine worked fairly well on the Kootenai and Flathead Forests. However, he thought the system could be improved by adding habitat type as a variable, and presented data showing losses were significantly related to habitat type.

Gary Pitman discussed the use of grams of wood produced/unit of foliage as a measure of lodgepole pine susceptibility to mountain pine beetle. Russ Mitchell compared thinned with unthinned lodgepole pine stands and found that most stands having high wood production/unit of foliage suffered little or no loss to MPB. In contrast, adjacent unthinned stands showing low wood production/unit of foliage had moderate to high losses of trees to MPB. Bob Dolph checked infested trees in both lodgepole and ponderosa pine stands and found that most infested trees had low wood production with only a few in the moderate category. No tree having high wood production/unit of foliage was killed.

Evan Nebeker discussed the selection of a southern pine beetle risk rating system for the state of Mississippi. Rather than "reinvent the wheel," he tested all the systems that had been developed for SPB throughout the South. From these, the one that performed best in Mississippi was selected. Ron Billings discussed the system of Garland Mason and others for risk rating stands to SPB in Texas from aerial photos. The system has worked well, and a plus for it is the data base has wide application in all aspects of forest management.

WORKSHOP: MANAGEMENT OF INSECTS OTHER THAN "BIG BUGS".

Moderator: Les McMullen

Twenty-two members attend and most participated in the workshop.

Tom Maher, Northwood Pulp and Timber Co., Prince George, B.C. gave a resume of his work with the lodgepole terminal weevil in the Cariboo Forest Region of central British Columbia, relating particularly to distribution of damage by tree height, leader growth and stand density. He discussed his results in relation to silvicultural procedures, particularly juvenile spacing, now in effect and how these might be modified.

Jerry Carlson, of the University of British Columbia, discussed the lack of effective control procedures for Sitka spruce weevil and the need to protect potential crop trees. He is proposing some work with repellents, specifically pine oil. Dennis Warkentin, of the University of Washington, described attempts to develop an IPM system for Sitka spruce weevil involving pesticide treatment, plantation spacing and host resistance. The most promising pesticide appears to be orthene. Hopefully spacing of plantations will reduce number of applications required since plantations 500 m from known source only had 1 per cent weeviling after two years. In addition, trees near the coast appear to be resistant and they are planning to look at trees in terms of the effect of climate on such things as growth, water pressure deficit, and stomatal activity. It was stressed that the importance of management procedures at the time damage occurs has to be reflected many years later at crop time for both of these insects.

John McLean, of UBC, discussed the formation of an IUFRO working party to facilitate world wide co-operation among researchers on insect problems associated with regeneration, establishment and early growth forests.

Ralph Thier, of USFS - Boise, Idaho, raised the problem of having to provide land managers with information on pests that have received little attention. He cited pine butterfly as an example. It seems to appear in about 30 year cycles, the epidemic being short-lived, but sometimes causing severe defoliation and sometimes not. It is difficult to know what options are practical. It was suggested that these short-lived epidemics provided the only opportunity to try any option and the opportunity should be taken.

The workshop ended at this point due to time limitations, although other topics various members (including the moderator) wanted to discuss had to be left in abeyance.

WORKSHOP: CURRENT MANAGEMENT STRATEGIES FOR SPRUCE BEETLE

Moderator: Ken Gibson

Participants: Scott Tunnock, Ed Holsten, Skeeter Werner, Dayle Bennett

John Hard was to have moderated the workshop and invited these participants: Scott Tunnock, USFS (FPM), Missoula; Ed Holsten, USFS (FPM), Anchorage; Skeeter Werner, USFS, (Research), Fairbanks; and Dayle Bennett, USFS (FPM), Albuquerque. As John was unable to attend the Conference, Ken Gibson, USFS (FPM), Missoula, moderated the workshop and presented some of John's research. Illness prevented Dayle's attendance so Terry Rogers, USFS (FPM), Albuquerque, presented Dayle's report.

Scott began the discussions by presenting an historical overview of spruce beetle management in the Northern Region. Major recorded infestations occurred in the 1950's, late 1960's, and are currently increasing. Current management includes strategies outlined by Schmid and Frye: hazard-rating of spruce stands; sanitation and treatment of logging residues; removal of infested and susceptible trees; utilization of trap trees where practicable.

Next, Ed presented the spruce beetle situation in Alaska. Approximately 260,000 acres of white spruce on the Chugach NF and 9,000 acres of sitka spruce in southeast Alaska are infested. Cooperative studies are developing a risk-rating system for white spruce and providing management alternatives to include the use of preventive sprays for spruce of high aesthetic value, the identification and silvicultural treatment of susceptible stands, and the salvage and utilization of recently killed trees.

Skeeter followed with details of current chemical testing. Three chemicals have now been field tested against the spruce beetle in white spruce. Both remedial and preventive properties of Dursban , Sumithion and permethrin were evaluated. As a remedial treatment, permethrin, at 0.25%, proved to be the most effective--with the fewest adverse effects on parasites and predators. Dursban was least effective. As preventive sprays, both permethrin (0.25%) and Sumithion (3%) provided excellent protection from beetle attack for 16 months.

Terry described beetle activity in the Southwest Region. Historically, resource managers have accepted mortality in stands of recreational or aesthetic value. Where timber values are primary, varying management strategies have been attempted--usually those detailed by Schmid and Frye. A current infestation on the Fort Apache IR, where approximately 17,000 trees on 4,000 acres are infested, was described. Short-term management alternatives include prioritizing stands for sanitation and suppression logging where feasible; the use of trap trees in some areas; and no-action in others. Long-term recommendations include hazard-rating of stands and silvicultural manipulation of susceptible ones.

Finally, Ken outlined the results of a study conducted by Hard on the Kenai Peninsula in Alaska. Surveying white spruce stands which had beetle attacks in 1980 and 1981, he discovered that plots on which mortality was highest were those on which trees were growing slowest. He determined, in that area, mortality was correlated with: first, slower than average growth for the past 5 years; second, heavily stocked stands; and third, increasing tree diameters. His recommendations for those stands included removal of slower growing trees, reducing stand BA to 50-120 ft^2/acre, and retaining fastest growing trees regardless of dbh.

WORKSHOP: USES OF BIOLOGICALS IN PEST MANAGEMENT

Moderator: Don Dahlsten

Participants: Jackie Robertson, Lonne Sower, Mitchell Miller, Don Kinn, Roger Ryan

The use of biologicals was defined in the broadest sense and growth regulators, pheromones and parasitoids and predators were discussed. This was a lively session attended by more than 50 people and informality and good discussion prevailed. The follow are brief statements of those who made more formal presentations.

Jackie Robertson—Insect growth regulators are promising alternatives to conventional chemicals and are ideally suited to use in IPM strategies. Two principal types—molt inhibitors (such as Dimilin) and juvenile hormone analogues (such as methoprene)—have been studied extensively on forest lepidoptera such as western spruce budworm. Although these chemicals show great promise, their use has been hampered by lack of commercial development.

Lonne Sower—Synthetic pheromone applied in Albany International fibers reduced reproductive rates of Douglas-fir tussock moths. Against low insect population densities, respective doses of 2, 9, or 36 g/ha resulted in 73, 92 or 100% fewer egg masses. At high population densities in New Mexico, 30 g/ha reduced egg mass numbers by 77%. Recent tests in B.C. with doses of 3 or 10 g/ha reduced oviposition by more than 60 and 70%. Pheromone disruption has also been used operationally against western pine shoot borer. The pheromone is registered and available. Operational applications at 5-10 g/ha have usually resulted in about 80% fewer infected teminal pine shoots.

Mitchell Miller—Preliminary results of exclusion-interference caging studies on three felled loblolly pines in May, June, and July 1981 showed increased mortality by Ips calligraphus in each succeeding generation. This mortality results from the effects of the total insect natural enemy complex, but does not exclude the effect of mites, nematodes, or other organisms transported to the host tree by Ips calligraphus, other beetles, or natural enemies. The data suggests that increases in mortality of the Ips calligraphus population is due to increased activity by natural enemies as their activity temperatures are reached. Exploratory studies of a lightning strike simulation technique with explosive detonating cord for field culturing of endemic southern pine beetles was described.

Don Kinn—The effect of endoparasitic nematodes on bark beetles generally involves: 1) reduced fertility, 2) delayed emergence, 3) altered behavior, 4) reduced flight ability, or 5) decreased adult longevity. Although some mite species are parasitic or predaceous on bark beetles, other species are mutualistic. The mites feed on nematodes, among which are the free-living stages of endoparasitic species. The beetle benefits from the predatory activities of the mite and the mite relies on the beetle for transportation to a new habitat. Mites present on forest pests may, therefore, serve as: 1) indicators of the physiological condition of the host, 2) the condition of the host's habitat, or 3) as an index for predicting the prospects for an increase or a decrease of the host population.

Roger B. Ryan—Parasites and predators are central components in all IPM programs developed to date, e.g., for pests of cotton, citrus, alfalfa, apples, tobacco, etc. The ways of using these beneficial natural enemies are described below along with a subjective rating of the feasibility of each method against forest pests. The rating scheme was: 1) High feasbility - success probably; 2) Moderate feasibility - success possible; 3) Low feasibility - success improbable. Introduction-The release of an exotic species which establishes a self-perpetuating colony at the expense of the pest population, thereby achieving permanent biological control.

Rating: 1 (against introduced pests); 2 (against native pests). Conservation-The prevention of the inadvertent destruction of natural enemies during pest suppression projects or routine management activities. Rating: 1. Promotion-A change in the environment to provide the requisites of natural enemies which are in short supply and therefore limiting, thus promoting an expanded enemy population above that which would persist in an unmanaged environment. Rating: 3. Augmentation-The release of natural enemies which may already be present in the environment, or which are not expected to persist, to obtain short-term pest reductions. Rating: 1 (when diseases such as viruses and B. t. are effective). The methods receiving the top rating, introduction and conservation, were examined in more detail for obstacles which are hindering wider use in forest pest management.

WORKSHOP: Uses of Photography in Forest Entomology

MODERATOR: William M. Ciesla

PARTICIPANTS: William M. Ciesla, Wayne Bousfield, and Larry Stipe

Forest entomology, like all professions, has a number of tools that are essential for its practice. These include diverse items such as microscopes, rearing cages, gas chromatographs, spray chambers, hand axes and aircraft. Photographs are an essential tool of the forest entomologist. They are used to illustrate both popular and scientific articles describing how to identify certain species, their status or new research findings. In addition, photographs are widely used as training aids. Aerial photographs are used to map damage.

The basic rules of photography apply regardless of subject matter. Items discussed were giving proper attention to background when taking close-up photos, use of depth of field to accent the subject of interest, framing to create the effect of depth, effective use of people for human interest and scale, use of telephoto and wide angle lenses and use of filters.

How to use a well composed photo to tell a story was emphasized.

Some pitfalls to avoid in photography which were discussed included cluttered backgrounds and making sure that horizon lines are horizontal.

In forest entomology, photographs are used to illustrate insects, their damage and what is being done to reduce loss. Other subjects include stand conditions or forest practices which tend to reduce or increase susceptibility to attack, and errors made during pest management operations.

Aerial photography with color or color IR film is a valuable tool for mapping infestation boundaries or as an intermediate sampling stage for estimating damage or loss. A large variety of camera systems and film formats are presently available for operational use. These range from 35mm photos taken with a standard SLR camera to 4 1/2 x 50 inch panoramic photos taken from a U-2 with an optical bar camera.

A program for determining aerial photo scale designed for the HP 97 programmable calculator was presented. This program displays scales for various sizes, print enlargements based on lens focal length, flying height, and film size.

WILLIAM M. CIESLA
Leader, Methods Application Group

WORKSHOP: CURRENT MANAGEMENT STRATEGIES FOR THE WESTERN SPRUCE BUDWORM
Moderator: Clinton E. Carlson
Participants: Willian Wulf, Robert Campbell, Jerald Dewey, Dennis Ferguson, Leon Theroux

Management strategies for the western spruce budworm Choristoneura occidentalis currently are not well developed. This workshop was an attempt to present current developments and concepts to reduce budworm impact.

William Wulf, Silviculture Specialist and CANUSA-West liaison in the USDA Forest Service Region 1 Timber Management Unit, discussed the intricancies of silvicultural prescriptions. Prescriptions must be tailored to the site and must consider numerous items besides the budworm. These items include ecological habitat type, forest cover type, slope, aspect, elevation, and numerous economic and social concerns. Conceptually, at least, if a sound biological prescription is applied to a unit, future budworm problems should be nominal.

Robert W. Campbell, Research Scientist from the Forestry Sciences Laboratory at Corvallis, Oregon, discussed his research concerning predation of budworm by ants and birds. Rather dramatic reductions of budworm numbers are attributed to bird and ant predation. Harvesting practices that increase bird and ant populations should reduce future budworm impact; research is needed concerning the effects of various harvesting and stand culture practices on budworm preditor populations.

Jerald E. Dewey, Supervisory Entomologist with Forest Pest Management, USDA Forest Service, Region 1, presented current management strategies used to reduce budworm impacts. Aerial spraying with the microbial B. T. and the non-persistent chemical insecticides acephate and carbaryl are available for areas which land managers believe warrant budworm population reduction. Individual high value trees, seed orchards, recreation areas, etc. can be protected from WSBW injury by spraying with ground equipment or by treatment with systemic insecticides.

Dennis Ferguson, Research Forester at the USDA Forestry Sciences Labotatory in Moscow, Idaho, discussed current research concerning the influence of budworm in regenerating stands in Idaho. He plans to include budworm impact in the stand prognosis model developed by the Moscow scientists. Forest managers will then be able to simulate budworm effects over a wide range of stand conditions.

Leon Theroux, Forestry Sciences Laboratory in Missoula, presented a methodology for measuring stage II budworm larval dispersal in the field. Sticky traps gridded throughout a stand are used to estimate larval densities relative to stand structure. Benefits and problems were discussed.

In perspective, it looks as if a strong integrated approach to budworm management, including proper silvicultural treatment along with some sort of insecticide application on very high value stands or individual trees, is promising in order to minimize WSBW impact.

WORKSHOP: MAJOR ECONOMIC ISSUES FOR THE 1980'S
Participant: Con Schallau

Expenditures for forest pest management increased 24 percent between 1970 and 1982, while forest pest research expenditures increased by 34 percent (both trends have been adjusted for inflation). But these trend data don't tell the whole story. Research funding peaked in 1975 at nearly 14 million (1972) dollars. Expenditures have since dropped to below 10 million (1972) dollars. Forest pest management activities lagged a bit, reaching a peak in 1979 of just a bit over 13 million (1972) dollars and will decrease to approximately 10.6 million (1972) dollars in 1982. The big question is whether or not the trend in funding levels over the past five or six years is indictive of things to come.

During the next few years, the need to revive our Nation's economy will greatly influence the size of the Federal budget. Most authorities agree that until the Federal deficit has been reduced sharply, interest rates will remain high. High interest rates of course, impede private investment needed to stimulate our economy. Forest pest management and resource funding, like that for most non-defense programs, will likely continue downward as a result of attempts to reduce the Federal deficit.

The long-run picture for forest pest management and research funding levels is a bit more difficult to predict. The long-run vitality of the timber industry and forest pest management and research activities are inextricably related. In this regard it's important to note that forecasters are saying that because of the unprecedented backlog in housing demand, plus the aging of the 1960 baby boom, there will be a major resurgence in home building during the 1980's. But deregulation of the banking industry could dampen the flow of mortgage money needed to finance the potential housing boom. In the future the homebuyer will have to compete with, for example, U.S. Steel for funds. To the extent that "reindustrialization" takes precedence over homebuilding, future demand for forest products may not be as robust as one might expect.

WORKSHOP: PEST MANAGEMENT PHILOSOPHIES
Moderator: Peter M. Hall
Participants: J. McLean, T. Maher

This workshop held on the afternoon of the last day was well attended. Philosophies behind activities are difficult to define and the discussion of the workshop often seemed to dwell on what was being done rather than why it was being done.

Dr. J. McLean (University of British Columbia) presented a short history of the development of pest management philosophy, tracing the concepts from forest entomology/pathology through integrated pest management up to the most recent idea of integrated forest protection. These changes in labels seem to indicate a shift from considering the pest only to considering the ecological system within which the pest is occasionally active. This type of perspective is necessary if resource managers are to avoid crisis management.

Tom Maher (entomologist with Northwood Pulp and Timber Ltd.) spoke from the industry standpoint and made the following points:

- need for a definition of pest management before we can discuss the philosophy.
- Require detection of population increases prior to significant economic losses.
- Forest entomologists should provide the land manager with operational, cost-effective detection and control techniques.
- There should be more integration of pest management with forest management.

Perhaps pest management, under any special label, should cease to be considered as a separate entity. Rather, forest management in general should incorporate knowledge of potential pest problems into basic forest practices. Ideally a pest management philosophy is identical to the resource management philosophy - to maintain or enhance the value of the resource being managed.

WORKSHOP: B.t.--AN UPDATE AND FUTURE USES

Moderator: Dayle Bennett

Participants: Larry Stipe, Jim Davis

The purpose of this workshop was to review recent projects where Bacillus thuringiensis (B.t.) was aerially applied to protect mixed conifer stands against western spruce budworm (WSBW) and to discuss future uses of B.t.

In 1980, a Forest Pest Management (FPM) task force was established to review past projects utilizing B.t. against WSBW and to submit recommendations to the Director of FPM on pilot testing B.t. against WSBW. It was the consensus of the task force that B.t. should be tested in a full-scale pilot project which included followup monitoring to determine the extent of any carryover effects. They recommended that pilot projects be conducted both in the Northwest and in the Southwest during the 1981 field season to determine if B.t., aerially applied, could be used to protect high value stands, ranging in size from 1,000 to 5,000 acres, against WSBW. As a result of this recommendation, two pilot projects of similiar design were conducted in the summer of 1981.

Larry Stipe discussed the design, results, and conclusions of the Northwest pilot project conducted on the Deerlodge National Forest, Montana. Results from this project show that at 21 days postspray, the average larval populations on the Dipel® and Thuricide® plots were reduced by 48 and 62 percent, respectively, as compared to a 26-percent average larval population reduction in the check blocks. Larval samples, egg mass samples, and defoliation ratings will be made over the next 2 years to determine the extent of any carryover effects of treatment.

Jim Davis presented the results and conclusions of the Southwest pilot project conducted on State and private lands in northern New Mexico. Results of this project show that the average larval populations after 21 days in the Dipel® and Thuricide® plots were reduced by 80 and 88 percent, respectively, as compared to a 60-percent reduction in the check plots. Jim also reported on observations and preliminary results which may show larval response to sublethal doses such as delayed larval development and reduced size of egg masses. Egg mass sampling and defoliation assessments will also be conducted over the next 2 years to determine the extent of any carryover effects of treatment on the Southwest project.

Future plans regarding the use of B.t. against WSBW were also discussed. In addition to followup sampling of the Montana and New Mexico pilot project, the State of New Mexico is planning to use B.t. on approximately 1,500 acres in and around sensitive areas such as waterways and inhabited areas as part of their proposed 1982 WSBW suppression project on 28,500 acres of infested State and private lands. Until followup data have been collected over the next 2 years, recommendations for using B.t. operationally to control WSBW will probably be limited to sensitive areas, or where no treatment would be the only alternative to chemical applications.

WORKSHOP : "BIG BUG" PROGRAMS--STATUS, FUTURE, ETC.
Moderator: Paul Buffam

About twenty participants discussed the pros and cons of the recent Research and Development programs and the outlook for the future. Some participants felt the accelerated research and development programs provided an opportunity to study all facets of an insect problem in a concerted effort. It was felt that work could be directed towards a coordinated effort including such things as population dynamics, early detection, evaluation techniques and suppression techniques, and prevention; including stand hazard analysis.

Some felt that work on "Big Bug" programs detracted from continuing efforts on other insect problems. Also, it was felt that some people had the belief that once a program ended, then no other work was necessary to complete efforts not quite finished by the close of the program. Therefore, there was a tendency to go from one program to the next program without cleaning up carryover work after a program was completed.

It was pointed out that we need to maintain some effort to make sure that program research is completed. For example: with Douglas-fir tussock moth, the outbreak model was developed after the tussock moth outbreak had subsided, so the outbreak model has not been validated through an outbreak cycle. Again, people felt that some work on important insects could not be done because no program dollars were available to accomplish this work. There seems to be the tendency to work on only those insects that are covered by a "Big Bug" program. This means that local problems, such as cone and seed insects, larch casebearer, and hemlock sawfly may not be researched because they are not critical enough nationwide to be supported for research dollars.

One advantage of an RD&A Program is that a number of people from varied backgrounds, including researchers at universities, and experiment stations, and Federal, State and private, pest management specialists work together to solve a common problem. In the case of the western spruce budworm and eastern spruce budworm, scientists from Canada and the U.S. have joined together in an international program to accomplish the same task.

It appears that, for the near future, the research and development program concept will continue. There will, perhaps, be at least one more (Big Bug) program and that will be related to western bark beetles. One of the reasons for pursuing the RD&A concept is that people in higher echelons seem to be convinced that this is the best way to obtain funding. Again, though, the disadvantage is that the funding that goes for the RD&A Program will siphon off regular funding that could go for the on-going research effort.

WORKSHOP: EVALUATING LARGE-SCALE DIRECT SUPPRESSION PROJECTS
Moderator: N. William Wulf
Participants: David G. Fellin, Terry J. Rogers, Donn Cahill, William M. Ciesla, Albert R. Stage

David G. Fellin, entomologist with Intermountain Forest and Range Experiment Station, discussed past spray projects directed at western spruce budworm in the Northern Rocky Mountains. Extensive treatment of whole entomological units with DDT did not result in lasting protection as populations rapidly resurged from survivors in sprayed areas, or in some cases, from migrating adults. Although immediate population reduction objectives were often achieved, a single application of insecticide had little influence on outbreak dynamics and many forests required respraying.

Terry J. Rogers, entomologist with Region 3, Forest Pest Management, reported on the Jemez aerial spray project for western spruce budworm conducted in 1977. Eighty-seven percent mortality was achieved with a single application of carbaryl and populations have remained low for 4 years. A similar untreated forest has sustained high populations. Although statistical comparison of treated and untreated areas cannot be made because of lacking replication and random assignment of treatments, it is interesting that population trends have been similar in the two areas. However, 1981 sampling indicates that populations may be increasing in the sprayed area but decreasing in the untreated area.

Donn Cahill, entomologist with Region 4, Forest Pest Management, reported on the 1979 acephate and carbaryl spraying for western spruce budworm in west-central Idaho. State and private lands were treated along with a buffer of National Forest land. As of 1981, the carbaryl treated area, where initial budworm mortality was estimated at 94 percent, has held up well with only a small portion becoming reinfested. The acephate treated area had an initial mortality estimate of 88 percent and populations have now regained pretreatment levels.

William M. Ciesla, entomologist with the Methods Application Group, provided an overview of variables to examine and sampling procedures associated spraying forest defoliators. Three variables should be monitored, the target insect, the resource being protected, and the quality of application. Long term year-to-year monitoring of target populations and tree or stand response is needed in order to validate our expectations of treatment benefits. Standard sampling procedures should be used so that the results of different spray projects can be compared.

Albert R. Stage, mensurationist with Intermountain Forest and Range Experiment Station, discussed sample design considerations for monitoring forest growth response to insecticide spraying. An untreated control area need not be sampled unless the prediction of treatment effects is suspect. No-treatment growth rates can be estimated from pre-treatment growth rates on the sprayed area, adjacent properly randomized untreated areas, or remote but biologically equivalent areas. Since conclusions cannot be drawn from a single pair of observations, accumulation of data from successive projects is essential. Variables other than growth may be sampled if models are available to translate field observations into stand yield estimates. The timing and duration of sampling are dependent on the immediacy of the growth response and the rate of pest resurgence. Sampling intensity should be sufficient to detect a growth difference that represents the break-even point between the spray and no-treatment alternatives.

Workshop: Host Susceptibility/Insect Interactions
Moderator: T. Evan Nebeker
Participants: Gary Pitman, Dave Perry, Fred Stephen, and Tim Paine

Nebeker introduced the basic subject area by elucidating the scope of the workshop and the efforts to concentrate on host condition rather than site and stand variables. A conceptual model was presented illustrating the relationship between host condition, the environment (or manipulated environment) and potential survivorship curves for insects. Discussion followed concerning current research efforts on southern pine attempting to define and seperate host susceptibility utilizing properties (chemistry) of the resin along with other physical features. Including the potential use of the Shigometer as a potential integrator of much of this information for rapid assessment in the field.

Pitman indicated that through stand manipulation they were able to alter the attack pattern of mountain pine beetle. When fertilized and thinned from below mortality dropped to zero 2 yrs after treatment and fertilizing alone had less of an affect. Addition of sucrose and sawdust dramatically reduced tree growth and available nitrogen and increased tree susceptibility. Tree kill in the untreated plots was significantly less than in the fertilized and thinned plots. There was a highly significant correlation among the quantitative expression of inner bark terpenoids, tree vigor (ratio bole increment inc. to leaf area) and treatments. Plots with low vigor trees (< 75) had lower levels of monoterpenes (g/g fresh inner bark wt) and significantly higher levels of tree mortality.

Perry discussed their approach in trying to determine why periodic epidemics of spruce budworm are common in Douglas-fir east of the crest of the Cascade range and endemic populations west of the crest with epidemics rare. Chemical differences in the foliage and palatability, lead to the following conclusions 1) The lack of chemical defenses in foliage from genotypes native to west of the Cascades suggests that the low frequency of budworm outbreaks in this area may be due to the complex of predators and pathogens which exist in these mesic, species-rich ecosystems, and 2) though the genetic potential for biochemical defenses in foliage of east-side trees may exist, its expression can be limited by environmental factors which reduce overall tree vigor.

Stephen and Paine discussed the strengths and weaknesses of their spot growth model - Pointing out its not sufficiently sensitive to tree or stand conditions, and that the relationship between beetles and host tree resistance and suitability has to be determined. They then proposed a conceptual model to describe the functional relationship between bark beetle populations and site/stand conditions. Included in this proposal was a plea for the standardization of the term risk and hazard both being analogous to the fire literature use, i.e. risk = chance of fire (spot initiation) as dictated by presence and activity of the causative agents (bark beetles) and hazard being a function of host condition, site and stand conditions that forms the threat of an outbreak. These conditions include oleoresin flow, oleoresin exudation pressure, crystalization rate, hypersensitive lesion length and monoterpene content, electrical resistance, tree basal area: sapwood basal area, mean height, mean diameter at breast height, mean age, stand density, site index, species composition, and basal areas. The functional relationship between rish and hazard is defined as the probability of an infestation starting and growing within a stand.

THIRTY-THIRD WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Final Business Meeting
Missoula, MT, March 4, 1982

Chairperson Buffam called the meeting to order at 10:25 a.m.

Chairperson Buffam thanked Temple Bowen of Sandoz Company for providing wine and beer at the wine and cheese party on Wednesday evening.

John Dale reported that a committee of Region 5, Forest Service and University of California people decided that Lake Tahoe would be the meeting site for 1983. Forest Pest Management of Region 5 will be in charge of local arrangements. Program chairperson was still undecided.

Nick Crookston reported that a committee composed of himself, Molly Stock, Roger Ryan, and Bruce Hostetler chose the Portland area as the 1984 meeting location. Alan Berryman stated that large cities tend to distract members from the work conference and results in poor attendance at workshops and panel discussions. A motion passed to have the 1984 work conference in Portland.

Nominating Committee - The committee nominated Ron Stark for chairperson, Bruce Hostetler for secretary-treasurer, and Kareen Sturgeon for the vacant councilor position. A motion was made to close the nominations and all were unamiously elected.

Common Names Committee - Scott Tunnock was elected as a new member of the Common Names Committee. Conference members approved new common names for two forest insects: western conifer seed bug for Leptoglossus occidentalis and ponderosa pine needle miner for Coleotechnites ponderosae. A motion was made and passed to table the request for changing the common name for Choristoneura occidentalis from western spruce budworm to western budworm.

Ethical Practices Committee - Chairperson and the 1981 receipient of the Ethical Practices Award, Tom Payne, indicated several prime candidates were considered for the award. However, he stated that one particular candidate that was usually rather subdued and inhibited due to his cold, dark habitat, accomplished unusual feats when subjected to a warmer environment with warm-bodied long-haired persons. Skeeter Werner appeared shocked at having ever done anything unprofessional.

Alan Berryman reported on his specific workshop on "Past and future prospects of the WFIWC". He summarized the major suggestions that resulted from the workshop:

1. The work conference has become too formal and lacks informal discussions that should occur at a workshop.

2. Younger work conference members are usually not invited to participate and should be given more reponsibility in leading workshops.

3. Workshop topics are tending to turn towards forest pest management and more forest pest research problems and problem solving should be included.

4. The Executive Committee is not assuming enough responsibility in directing program planning for work conferences.

5. The work conference theme should be developed by the Executive Committee, and this should be effective for the 1983 conference.

6. A free afternoon during the work conference tends to disrupt the workshop concept and could be used to discuss previous workshops or panel debates.

7. Panels should be limited to formal debates and not merely a place for presentation of formal papers.

8. Workshops should be less structured. Presently only certain people are asked to present their programs or research results whereas everyone at a particular workshops should engage in discussion of a particular problem.

9. The Executive Committee should include these suggestions in planning the 1983 work conference.

Chairperson Buffam suggested the 1983 program committee plan a 1 to 2 hour session on the suggestions from Berryman's workshop.

Evan Nebeker invited members of the WFIWC to the 1982 SFIWC to be held June 8-10, 1982, in Blacksburg, Virginia. This will be a combined forest insect and forest disease work conference.

Work conference members thanked Ken Gibson, Mark McGregor, Scott Tunnock, Hu Meyer, and Carma Jean Gilligan for their role in planning and organizing the 1982 work conference.

Chairperson Buffam thanked Molly Stock, Bill Ciesla, Stu Whitney, and John Laut for serving as councilors during the past two years.

Bill Ciesla asked that conference members thank all of the Executive Committee for their time and effort dedicated to the work conference.

The meeting was adjourned at 11:15 a.m.

TREASURER'S REPORT

Thirty-third Western Forest Insect Work Conference
Missoula, MT, March 4, 1982

Balance on hand March 1, 1982	(+)	$ 621.75
Income from Missoula Conference:		
Registration (146)	(+)	$2,620.00
Sale of 1980 and 1981 Proceedings	(+)	$ 22.50
Balance	(+)	$3,264.20

Expenses of Missoula Conference:		
Meeting Supplies	(-)	$ 19.05
Souvenir Hats	(-)	$ 273.50
Wine and Cheese Party	(-)	$ 270.00
Coffee	(-)	$ 210.00
Luncheon	(-)	$ 930.60
Room and Projector Charge	(-)	$ 145.00
Balance on hand March 4, 1982	(+)	$1,416.10

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-Treasurar 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

Amendments 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.

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