PROCEEDINGS

THIRTY-EIGHTH ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

PARK CITY, UTAH

MARCH 2 - 5, 1987

Not for Citation

(For Information of Conference Members Only)

Prepared and Printed at

Intermountain Region

USDA Forest Service

Ogden, Utah

Front Row, L-R: Fred Stephen, Tom Payne, Eric Smith, Pete Lorio.
Middle Row: John Stien, Bill Thoeny, Stan Barras, Salma Talhouk, Dave Nielsen, Jesus A. Cota, Stephen Cook, Ed Holsten.
Back Row: Terry Shore, Gene Lessard, John Moser, Steve Burke, J. Robert Bridges, Timothy Paine, Staffan Lindgren.

Front Row, L-R: Mike Wagner, Karen Clancy, Hugh Barclay, Leslie Chong.
Middle Row: Barry Bollenbacher, Dave Schultz, Garland Mason, Herb Kulman, Gary Daterman, Fred Baker, Bill Bedard, Ralph Thier.
Back Row: Larry Stipe, Tony Smith, Mark McGregor, Bill White, Tom Hofacker, Lynn Rasmussen, John Foltz, Cliff Ohmart.

Front Row, L-R: Dave Wood, Mitchel Miller, Dave Holland, Evan Nebekar.
Middle Row: Don Dahlsten, Dick Schmitz, J.W. Schmid, Bob Cain, Bob Celaya, Sara Zimmer, Sandy Gast, John Wenz.
Back Row: Les Safranyik, Robert Wolfe, Andy Eglitis, Dave Bridgwater, Dayle Bennett, Ken Gibson, Peter Hall.

Front Row, L-R: Ann Lynch, Garry Domis, Roger Sandquist, Dennis Hart.
Middle Row: Ken Lister, Russ Cozens, Julie Weatherby, Andy Knapp, Tim Schowalter, Ladd Livingston, Wayne Bousfield, Jed Dewey.
Back Row: John McLean, C.J. DeMars, Dick Mason, Boyd Wickman, Chuck Dull, George Gruell, Art Stock.

Front Row, L-R: Bruce Hostetler, John Laut, Karl Stoszek, Bob Tisdale.
Middle Row: Chris Niwa, John Neisess, Dick Parmeter, Brian Geils, Tom Phillips, Scott Cameron, Mike Jenkins, David Frantz.
Back Row: O.A.A. Pillai, Gene Amman, John Anhold, Ben Moody, Steve Teale, Bob Acciavatti, Bernie Raimo.

Front Row, L-R: Ron Billings, David Long, P.B. Kale, Zhao Yi.
Back Row: Linda Wadleigh, Borys Tkacz, Bob Gara, Cindy Barton, Ann Keysor.

Workshop Summaries:

PROGRAM

Thirty-eighth Annual Western Forest Insect Work Conference
Park City, Utah - March 2-5, 1987

Monday, March 2

3:00 p.m.	Registration -- LOBBY
6:00 p.m.	Evening Mixer -- GRUB STEAK
8:00 p.m.	Executive Meeting -- LOUNGE

Tuesday, March 3

7:15 a.m.	Registration -- LOBBY
8:30 a.m.	Initial Business Meeting -- THEATER
9:15 a.m.	Chairperson's Address -- THEATER
9:30 a.m.	Break (Final Registration) -- LOBBY
10:00 a.m. THEATER	PANEL: What is the future of forest entomology? MODERATOR: David Wood PANELISTS: Les Carlson, Garland Mason, John Fulkerson, John McLean, Peter Hall, David Overhulser
12:00 Noon	Lunch
1:30 p.m. THEATER	PANEL: Vegetation Management MODERATOR: David Holland PANELISTS: George Gruell, Russ Cozens, John Laut
3:00 p.m.	Break (Group Pictures) -- LOBBY
3:30-5:00 p.m.	WORKSHOPS
COALITION #1	1. Use of Silvicultural Practices to Control Insects in Vegetation Management Programs MODERATOR: Barry Bollenbacher
COALITION #2	2. Role of Fire in Insect Ecology and Its Use in Vegetation Management Programs MODERATOR: Bob Gara
COALITION #3	3. Use of Semiochemicals to Manipulate Insects in Vegetation Management Programs MODERATOR: Peter Hall
SILVER KING #4	4. Use of Chemicals to Control Insects in Vegetation Management Programs MODERATOR: Jesus Cota
5:15-6:00 p.m. THEATER	Bark Beetle Movies - Gerhard Gries 1. Breeding Biology of *Pityogenes chalcographus* and *Ips typographus* 2. Development of a Gallery System

Wednesday, March 4

8:00 a.m. THEATER	PANEL: High Tech Applications in Forest Pest Management MODERATOR: Bill White PANELISTS: Bob Acciavatti Chuck Dull Bob Coulson
9:30 a.m.	Break -- LOBBY
10:00 a.m.	WORKSHOPS
COALITION #1	1. Interactive Videodisc MODERATOR: Mike Jenkins
COALITION #2	2. Geographic Information System MODERATOR: Bill White
COALITION #3	3. Artificial Intelligence and Expert Systems MODERATOR: Jesse Logan
SILVER KING #4	4. Remote Sensing MODERATOR: C. J. DeMars
11:30 a.m.	Lunch
12:15 p.m.	FIELD TRIPS:
BUS STOP by Grub Steak Departs 12:28	1. Vegetation Management in Park City (ski slope tour) LEADER: Mike Jenkins
PARKING LOT WEST OF SWIMMING POOL	2. Mountain Pine Beetle and Mistletoe (Cross country ski tour) LEADER: Borys Tkacz
1:00-7:00 p.m. COALITION #1-2	EQUIPMENT AND POSTER SESSION CONTACT: David Holland
7:30-9:00 p.m. COALITION #3	Graduate Student Research and Rap Session MODERATOR: John McLean

Thursday, March 5

8:00 a.m.	WORKSHOPS:
COALITION #1	1. Hazard Rating for Insect Infestation MODERATOR: Terry Shore
COALITION #2	2. Recent Tests of Bark Beetle Semiochemicals MODERATOR: Mark McGregor
COALITION #3	3. Insect-Tree Disease Interactions MODERATOR: Fred Baker
SILVER KING #4	4. Defoliators MODERATOR: Dick Mason
9:30 a.m.	Break -- LOBBY
10:00 a.m.	WORKSHOPS:
COALITION #1	1. Insects of Seeds & Cones and Their Management MODERATOR: Ralph Thier
COALITION #2	2. Insects of Regeneration and Their Management MODERATOR: Bill Bedard
COALITION #3	3. Bark Beetles MODERATOR: Gene Lessard
SILVER KING #4	4. Recent Tests of Defoliator Semiochemicals MODERATOR: Gary Daterman Chuck Schwalbe
11:30 a.m.	Lunch
1:00 p.m.	Final Business Meeting -- THEATER
2:00 p.m.	Break -- LOBBY
2:30 p.m.	WORKSHOPS:
COALITION #1	1. Models to Predict Insect Outbreaks and Losses MODERATOR: Jesse Logan
COALITION #2	2. Endemic Population Studies MODERATOR: Les Safranyik
COALITION #3	3. Biological Control MODERATOR: Don Dahlsten
SILVER KING #4	4. Anti-Herbivory Compounds and Their Role in Insect-Host Interactions MODERATOR: Rex Cates
4:00 p.m.	Adjourn 38TH Work Conference

THIRTY-EIGHTH WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Executive Committee Meeting
Park City, Utah - March 2, 1987

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

Present were:

Dick Schmitz, Chairperson
Dave Overhulser, Councilor 1985
Terry Shore, Councilor 1986
Gene Amman, Program Chairperson 1987
Dave Holland, Local Arrangements Chairperson 1987
Mike Wagner, Program Chairperson 1988

Absent were Secretary/Treasurer Ben Moody and Councilor Nick Crookston.

Minutes of the 1986 Executive Meeting, the Initial Business Meeting, the Final Business Meeting and the Treasurer's Report were read and approved.

Larry Stipe reported that the Common Names Committee had lost Scott Turnock and suggested John Moser as a replacement. It was further suggested that we should have a replacement from the West.

Chairperson Schmitz informed the members that Ron Stark just had surgery and was not able to work on the WFIWC Historical Committee, but Ron will submit a report for the Proceedings.

A note from Peter Hall, Chairperson of the Commercial Displays Committee indicate that we should leave judgement up to each program committee, and that Commercial Displays should not be discouraged.

Nick Crookston, Chairperson WFIWC Honor Award Committee, sent a report proposing that an award similar to SFIWC be initiated. Letters sent out to members, but little response received. It was suggested that an award be given for "new and innovative work" instead of "long service with large numbers of publications".

Dave Holland, Local Arrangement Chairperson, reviewed the 1987 WFIWC Program and saw no problem, but was concerned about the low number of registration at the time.

The WFIWC Meeting venues were noted as: Flagstaff, NM, March 7-10, 1988 and possibly Berkeley in 1989.

Awards to Les Safranyik, Dave Wood, and Jacqueline Robertson were listed to be reported at the Initial Business Meeting.

The following members, Les Safranyik, Boyd Wickman and Mark McGregor were selected to the Nominations Committee, to select a new Secretary/Treasurer, one councillor, and a member for the Common Names Committee.

The meeting was adjourned at 9:00 p.m.

THIRTY-EIGHTH WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Initial Business Meeting
Park City, Utah, March 3, 1987

Chairperson Schmitz called the meeting to order at 8:30 a.m. and welcomed members to beautiful Park City, Utah.

No tribute was made to deceased member as none was reported.

Minutes of the 1986 Final Business Meeting and the Treasurer's Report were read and approved.

Special awards received during 1986-87 by Dave Wood, ESA Founders Memorial Award and Jacqueline Robertson, IUFRO Scientific Award, were mentioned and applauded by the membership.

Ron Stark was recovering from surgery and was unable to report on the History Committee, but he was to have a report for the WFIWC Proceedings. Ron's address was made available for members to wish him well on his recovery.

Peter Hall, Chairperson of the Sponsorship/Commercial Displays Committee submitted a report to Chairperson Schmitz, in which he suggested that most people were not opposed to displays and that the displays be left to the local program chairperson(s) to decide.

The motion "that it be the Policy of the WFIWC that commercial displays that advance the science and practice of forest entomology may be part of the conference program. Further, that the content and extent of such displays shall be left to the discretion of the local program committee", was approved by a majority vote.

Larry Stipe reported the loss of Scott Turnock from the Common Names Committee and suggested that a replacement be sort.

Nick Crookston could not attend but sent a report that there was very little response by members to his letter on the Honor Award. He mentioned that he was unable to continue as the Chairperson of the Honor Award Committee and suggested that Molly Stock had expressed some interest in this. As no other nominations were received from the membership, it was decided by the Chairperson that Molly be asked to take over the Honor Award Committee.

Members were invited by John Foltz to attend the SFIWC at San Antonio on August 10-13, 1987.

Mike Wagner invited members to the 1988 WFIWC in Flagstaff, Arizona, March 7-10.

A Nominations Committee of Les Safranyik, Boyd Wickman and Mark McGregor was charged with finding a new councilor and a Secretary/Treasurer positions held by Nick Crookston and Ben Moody, respectively.

Local Arrangement Chairperson, Dave Holland introduced the members of the local arrangements committee, and mentioned that extra commemorative coffee cups were on sale for $5.00 each.

Program Chairperson Gene Amman reminded panel and workshop moderators to send summaries for the Proceedings to Ben Moody, Secretary/Treasurer by 31 April, 1987.

The Chairperson's Report was read and accepted.

The Secretary/Treasurer informed members who attended the 1986 WFIWC to collect their copy of the 1986 Proceedings from the registration desk, and that extra copies are on sale at $4.00 per copy.

The meeting was adjourned at 8:55 a.m.

TREASURER'S REPORT

Thirty-eighth Western Forest Insect Work Conference
Park City, Utah, March 2, 1987

Balance on hand March 7, 1986	(+) 5,550.54 CAN
Expenses:	
Postage	(-) 108.96
Printing of 1986 Proceedings	(-) 1,132.79
Bank Charges	5.00
Income:	
Interest	(+) 190.04
Balance on hand March 2, 1987	(+) 4,493.83 CAN (3,303.00 US)

CHAIRMAN'S ADDRESS

38th Annual Meeting of the
Western Forest Insect Work Conference

Park City, Utah
March 3, 1987

It's customary that the keynoter or chairman's remarks set the stage for the Conference proceedings, to review noteworthy changes in our field since our last gathering, and outline what are likely to be the challenges at the immediate future. Your program committee felt that discussion of our future warranted greater consideration than might be given in such opening remarks. Therefore, as you'll note in the program, our eyeopener will feature a panel--moderated by Dave Wood--dealing with the future of forest entomology. So I'll leave the future to Dave and his panel and restrict my remarks to some concerns I've had regarding our profession.

A review of U.S. and Canadian insect condition reports, or as Ross McDonald once coined them, "Ain't It Awful Reports," suggests that with exception of the gypsy moth, the insect problems have not changed much in recent years. In the level of damage, subsection bark beetles, the mountain pine beetle still reigns number one. Much of our detection, control, and research efforts on both sides of the border are focused on this insect--especially in British Columbia and Western Montana. The CANUSA Spruce Budworm Program has run its course but this defoliator has not, and as a result, land managers in the Pacific Northwest have proposed a large-scale suppression effort for this summer. The appearance of the gypsy moth in the Western States has added a new concern to the list of forest insects demanding our attention, especially in Oregon.

More drastic changes are occurring in the way we plan to manage our forests. In the U.S., the long-range management plans now required for each National Forest have made the manager especially aware of the impact of insects affecting sawtimber. At the same time, reductions in the anticipated timber base, resulting from "set asides" for wilderness or unregenerated or poorly stacked stands, has also made the manager acutely aware of the importance of insects responsible for growth loss in younger stands. The problems are not new, but the system of accountability is.

Accordingly, the demands on us to provide improved systems to rate stand hazard and susceptibility, to quantify impacts, and to provide an array of suppression strategies suited to protecting timber, along with wildlife, water, and recreational values, will intensify. All at a time when the availability of resources, in terms of dollars and people, has been cut drastically on both sides of the border. For example, in 1976 the Intermountain Research Station had six research entomologists. That number has dwindled to two today. Similar reductions have occurred in our Regional Pest Management groups.

There has been much talk about the challenges of the '80's. For most of us, the biggest immediate challenge is to perform our part in the management of these resources with fewer dollars and people than we'd become accustomed to in the 60's and 70's. The challenge is further complicated by the need to devise or revise suppression strategies to meet current environmental constraints. On the one hand, these restrictions have often limited the application of pesticides, complicated the registration of behavioral chemicals, and restricted timber harvesting in ways that lessen the effectiveness of strategies based on silvicultural treatments. On the other hand, they have forced us to step back and look anew at our pest problems and begin to develop a new mix of strategies and treatments compatible with current concerns for the environment.

One approach to achieving that end is to integrate the "high tech" type tools that are becoming increasingly available. A glance at your program suggests your program committee had similar thoughts. Improved remote sensing capabilities and use of behavioral chemicals to locate and quantify incipient populations should improve our accuracy for predicting when population levels are approaching intolerable levels. Improved methods for assessing stand hazard and susceptibility will aid the manager in setting treatment priorities. Use of semiochemicals to concentrate populations to increase the effectiveness of silvicultural or chemical treatments as has been employed in the High Country Project in Colorado or by Peter Hall and his group in British Columbia typifies new approaches to old problems. Modeling efforts like those encompassed in Bill White's "IPIAS" program will provide the manager with an array of potential suppression actions and their consequences, thereby improving the decision-making process. To develop suppression strategies that match environmental concerns will require a greater appreciation for the lead time and resources needed to develop the necessary data base. It will also require that a more sustained balance be struck between support for long-term basic research and that required to apply existing knowledge.

But I also believe if we are to succeed in meeting this challenge, we will need to place greater emphasis on developing and employing preventive strategies. Ross McDonald, in an address before this group several years ago, summed it up well when he suggested that our real problem is that we are a catch-22 discipline. If we were really successful, there would not be insect outbreaks. We would be able to advise on preventive action all the time, rather than devoting most of our resources to the "Ain't It Awful" situations that are often beyond existing capabilities to suppress quickly and effectively.

Despite the tough financial times, it is time we devote greater attention to understanding and exploiting to our advantage factors that regulate endemic populations. We need to improve our methods for detecting populations at these low levels so that ultimately we can provide the manager with the means to prevent populations from building to outbreak levels. Admittedly, it's difficult. These populations take considerable time to locate and often collapse before the key factors governing their dynamics can be determined. Nonetheless, the knowledge to be gained is essential to providing the manager with treatments he can employ early in the infestation cycle when suppression actions are less costly and more likely to meet with success. Such action would also minimize the drastic revision outbreak situations now impose on long-term forest planning.

In summary, the magnitude of our pest problems has not changed much in the last few years, but the dollars and/or the people available to do the job have been reduced significantly. Changes in our forest planning have forced the land manager to take a longer-term look at the factors affecting productivity, including insect pests. This change has presented us with an opportunity to provide input regarding pest problems early in the development of management plans. This offers us the opportunity to shift our principal effort from controlling outbreaks to preventive actions--the ultimate objective of our efforts.

At times like these, when the resources to do the job are in short supply, it's easy to leave the technology transfer to someone else; to hand the manager a sketch map with the notation that build-up ratios or defoliation have increased and it is time to take action; or send the manager your latest publication describing a new control technique, rather than taking the process a step further and outlining and participating in a field test. To increase and maintain the support we need to do the job, there is a need to increase that sort of participation--not succumb to the temptation to stand pat.

Finally, there is still room for improvement in the manner in which we interact with our forestry colleagues. I am reminded of the comments of a mentor and friend, Chuck Wellner. Chuck spend many years with the Intermountain Station guiding timber management research. He never really accepted the term "pest management." He felt pests and their control are only part of the resource management job. He considered forest protection to be an integral part of silviculture. He observed that when you take it out of that context and treat it apart from the overall management of the ecosystem, you tend to get into trouble. You also lose the understanding, trust, and cooperation between disciplines that is essential to effective forest management.

The program assembled by your Program Chairmen, Gene Amman and Mike Jenkins, offers an excellent opportunity to discuss the merits and shortcomings of new approaches for solving familiar problems. Over the years, we have taken pride in the fact that the success of this Conference is attributable to a workshop format that has encouraged participation of all those present. I encourage you to continue that tradition by making certain your ideas, interpretations, and findings are made known.

In closing, I wish you all a productive Conference and a pleasant stay in Park City.

Dick Schmitz
March 3, 1987

PANEL: WHAT IS THE FUTURE OF FOREST ENTOMOLOGY?
Moderator: Dave Wood
Panelists: Dave Wood, Don McLean, Dave Overhulser, Peter Hall, Garland Mason, Lester Carlson, John Fulkerson

The panel was organized to obtain viewpoints representing universities and state, provincial and federal land managers in the U.S. and Canada.

Universities - Dave Wood. I conducted a survey of some 30 universities in the U.S. where forest entomology is taught. The following conclu sions were derived from 25 respondents, a very respectable 83% return.

1. Forest entomology as a sub-discipline of entomology and forestry is in a state of general decline. Although graduate student interest remains moderate (62 M.S. + 37 Ph.D. in past 5 years), job prospects are dim over the next 5-10 years for university teaching and research positions (6). Presently, there are 51 students but it was not clear how many are Ph.D. or M.S. candidates. Employment in some sub-area of entomology remains high (80%) for those trained in forest entomology.
2. Important areas of training in descending order of importance are: ecology/population dynamics (by far the most important), behavior, insect/plant interactions, and molecular biology. Biometrics/ systems sciences, IPM, biological control and insect pathology were named by a few. To survive entomologists must emphasize research along the continuum from basic to applied research, modeled after medicine. Also we need a close relationship with pathology, and a commitment to long-term research.
3. Land managers do not, in general, appreciate the value of forest entomology. However, this view is poorly documented.
4. Most forest entomologists believe in the importance of their discipline, and that when the present timber surpluses disappear, a greater demand for forest protection will develop.
5. A general concern exists for the decline of support for forest biology in general. Some believe that an initiative at the national level is required to protect and encourage this important intellectual resource during this depressed period. However, before this can be accomplished, good documentation of our present position will be needed.
6. Are we following the same pathway as Forest Pathology, i.e., a decline of 50% of the forest pathologists west of the Great Plains in 20 years, i.e., less than 15 present today?

- Don McLean, Faculty of Forestry, The University of British Columbia, Vancouver, B.C., Canada. Most forest entomologists are big E entomologists and usually reside in Departments of Entomology. How do others see us, especially in our role as forest entomologist? Big F or small f forestry? In our hearts, probably small f because the insects we have chosen to work with just happen to have quite an impact on forest trees. Perhaps we should stop to consider where forestry has been heading in recent years. Large tracts of land have been

harvested. Re-establishment of the crop is now a high priority. We have to work alongside the silviculturist. We must be there to advise on the risks at each stage. And what of big F forestry -- The Forest Industries? Here the rules are totally different. You need to address $$, point to the bottom line. Foresters are changing. I think too that the type of entomology practiced in the name of Forest Entomology has also changed. We must put our shoulder to the wheel in quality control (harvesting and processing as well as with the silviculturists as they grow the next forest). We must join the team!

State and Provincial Land Managers - Dave Overhulser, Department of Forestry, Salem, OR. State entomologists were initially hired in the 60's and 70's with an inducement of federal funds to help support the position. The principal role envisioned for the state entomologist was that of a liaison for cooperative survey and suppression projects. Typically, a single professional was hired and stationed at the state capitol. Since the operational forestry agencies administered the forest insect control laws, the entomologist was attached to agencies whose primary mission is fire suppression. In the last decade, the operating environment for the state entomologist changed dramatically, but their roles were never redefined. Changes in the working environment include a decreasing number of direct suppression projects, the virtual obsolescence of the state mandatory insect control district, a withdrawal of federal funds to support the position of state entomologist, and the increasing public perception that forest insect impacts are insignificant and cannot be economically controlled.

What changes are needed now and in the future?

We will need to revise the antiquated laws regarding forest insect control.
We will need a clear mandate to operate in an extension role and to provide the critical mass to effectively carry out a program.
We will need accurate impact estimates for forest insect problems on a state-by-state basis.
We will need to develop programs that allow us to quantify our activities and the benefits to the public.

What skills and interests should a state entomologist possess?

The ability to effectively communicate with the general public, clients, and those evaluating pest management programs.
The skills to manage a program increasingly scrutinized by legislators on its ability to deliver a product.
The willingness to make recommendations based on a best guess?
A fluency with various types of information systems.
A strong interest in insect impacts on the forest resource.
A good background in forestry, biology, and insect ecology.
The flexibility to work in other areas of forestry if required.

The future of state entomologists is not bleak if we can gradually redefine our role and still make a measurable contribution to resource protection.

- Peter Hall, Protection Branch, Ministry of Forests and Lands, Province of British Columbia, Victoria, B.C. The future of forest

entomology should be clearly indicated by the evolution to date. Forest entomology can be loosely defined as the study of the biology and behaviour of insects in a forest ecosystem. In practical terms, the discipline is concerned with understanding a relatively small subset of insect species, determining the type and scope of the damage they cause, and developing ways to reduce that damage. All of this must be done within the objectives dictated by forestry practices and management. The objectives of forest management are the ones which determine whether or not a particular insect or level of damage is of concern. The practice of forest entomology is but a part of forest management - management or control of forest insects is not an end unto itself. I should emphasize here that not only must entomologists appreciate and accept their role in forest management, but that foresters must also increase their appreciation for what the application of forest entomology can do for them - that is, the place of forest entomology in forestry must be recognized and suitably supported by all concerned.

When the forest resource was considered to be extensive and, to all intent inexhaustible, the practice of forest entomology research and operations appears to have been directed at studying insects during crises or when they increased to the point where the damage could not be ignored. In the past, the approach has been the same for most forest insect outbreaks - development and application of treatments to reduce populations and therefore limit the damage sustained in any one outbreak. The objectives were to deal with insects alone and no attempts were made to manipulate the forest to reduce the underlying causes of outbreaks or to assess actual levels of damage. The development and application of relatively short term, direct treatments was valid given resource management objectives. Studies were also undertaken to rectify gaps in information with the view of improving management systems and to provide quantitative methods to justify application of treatments.

In many areas, the forest resource is now known to be finite and not easily replaced. We see an increasing need to impose rather intensive management regimes to maintain or enhance the resource available. This process of increasing management effort has had and will continue to have a great effect on how forest entomology is perceived and implemented.

The traditional insect species will continue to be problems that must be dealt with from a forestry perspective. But, as management efforts increase to maintain or enhance production on a smaller resource area, heretofore "innocuous" insects traditionally causing background levels of damage will assume grater importance. Entomological input will be required in developing rational management regimes and entomologists will have to provide an array of treatment or management options.

And now the future of forest entomology becomes clearer. We will continue to develop and provide the classic pest management services, detection surveys of various types, damage appraisal methods and estimates, direct control treatments where and when deemed suitable for whatever reason, and, monitoring of the effectiveness of such programs to provide feedback to improve future protection programs. However as we move into more intensive forest management programs our ability to

establish and protect these second growth stands becomes extremely important.

Forest entomology specialists will also be required both in government management agencies and in the private sector. These specialists must be able to provide assistance and input to other forest management programs to modify harvest schedules and silvicultural prescriptions so that they are more effective at attaining management objectives.

Foresters will need to have some background and appreciation in entomology. Pest managers will have to have a background and appreciation of forest management practices. In the future, greater emphasis must be placed on looking at both the insect and the forest and their interaction. In many respects, the forestry perspective will take precedence. Forest entomology is now, has been in the past, and will continue to be, very much a part of mainstream forestry. It must be remembered, however, that Forest Entomology is a union of two sciences - Forestry and Entomology and the fact that it is not called Entomological Forestry should be appreciated by all concerned.

Federal Land Managers - Garland Mason, USDA Forest Service, Washington, D.C. IPM concept will carry us into the future. Our goals will continue to be to lessen the number and lower the amplitude of outbreaks. We will not have as much flexibility to take action as in the past because of environmental concerns. Since 1980, 31 entomologists have retired from the U.S. Forest Service. Eleven have been replaced, mostly from within the organization. In 1970 there were 71 entomologists; in 1980, 84; and in 1987, 64. The mean age is 48 years, and 30 are over 50 years.

- Lester Carlson, Canadian Forestry Service, Ottawa, Canada. The Canadian forest entomology community includes a broad cross-section of sub-disciplines, but is predominantly filled with scientists researching economically important pest problems. Their research primarily deals with population dynamics, control methods, and descriptive entomology. There are over 100 forest entomologists in Canada, about 55 of which work for the Canadian Forestry Service. The university sector, while a major supplier of entomologists, has very few programs in forest entomology associated with the forestry faculties.

The first and probably the most challenging problem will result from the "new forest" which is developing with the thrust of intensive forest management. Forest management systems for the new forests will include the use of genetically improved trees, land classification to direct the development of the new forests to ensure that they are on the most productive sites, and fertilizers. The main emphasis will be on fibre production (pulp and lumber). This new forest could be a monoculture or a complex of mixed species. It will require a new acceptance by the public and scientific communities.

With judicious management fewer forest lands will be used for extensive forestry, more land will be available for wilderness areas. Several assumptions have to be made if management is to effect a reasonable plan for the development of the forest. First, any new forest will be developed from vastly improved and expensive stock and as such will need protection if there is to be a return on the investment. Second, regardless of what we do, insects and diseases of one sort or another will always be with us, and under intensive forest

management, the problems will likely be different from what we now know and in all probability will become worse. Third, our array of control methods will become increasingly limited either through withdrawal of chemicals or lack of appropriate biological pesticides (which some prefer to call biorationals).

As silviculture becomes more intensive we will see an increased use of high quality fibre yielding species. To ensure that these high quality trees are available, considerable effort will have to be spent on the development of productive seed orchards that will need equal or better protection. Technology will tell us which species will be needed. As wood supplies from one become less available, others will be used through the development of new technologies. Therefore, it will be hard to predict where the protection problems will be.

Another major problem facing the forest manager is the increased difficulty that is being experienced in the development and registration of the pesticides needed to protect the new forest from devastating pests. The difficulties in coping with pesticide regulations are not likely to go away. In addition, increased pressure from environmental groups and concerned individuals will, in all likelihood, restrict the use and development of new pesticides.

If the assumptions I just made become reality there will be fewer chemical pesticides available in the future for the control of forest insect problems. The tough restrictions we have come to know in the forest community are now reaching into the rest of the agricultural community and will further restrict the use of effective chemicals for control.

The quickness of the development of resistance in a pest to a chemical is astounding. Most new insecticides are predicted to last only a few years under intensive use. Our problem is that forestry's arsenal of chemical pesticides is small. There are only three insecticides that can be used for large-scale operations, matacil, fenitrothion and B.t.; and only three herbicides for vegetation control, 2,4-D, glyphosate and Velpar. Anything that would render any one of these tools useless could spell disaster.

On this same line you may be aware that an insect pest of stored grains has been found to carry resistance to Bacillus thuringiensis. This should make us wonder how much should be spent on placing the B.t. toxin gene into trees, as they are doing with white spruce at the Plant Biotechnology Institute in Saskatoon.

The use of B.t. and viruses has become more attractive in the past few years. The successes have been spectacular. In Canada we support the Commonwealth Institute for Biological Control, but only at a meager $125,000 a year. In forestry we are only covering the services of one researcher in Europe to look for potential parasites and predators of six different insect problems.

The issue of pesticide use has increased the concern for environmentally sound management of the forests. The resultant pressures are both real and imaginary and therefore are difficult to approach. In fact, the operative word here is issue, not problem. A problem is something that you set out to solve, and with time, probably can. An issue, on the contrary, cannot be solved, only resolved. In one case you deal with hard facts for solutions, and in the other you deal with a volume of information, which is difficult to interpret, that will help resolve the issue. Land use conflicts, health and welfare

concerns, conservationist activities, environmental hazards, and the climate itself all impinge on management of the forests.

Solving many of the insect problems we will encounter will require a better knowledge of the insect and its lifestyle in the new forests; e.g., the need for a good understanding of the population dynamics of the insect under new and varying conditions. To integrate control protocols we will have to know how to use the available pesticides to effectively control the pests and use the proper type of biorationals to complement the management of the forest.

On top of all the regular biotic pressures of the forest ecosystem add the abiotic ones of potential climate change and air pollution.

It is here that I should make a point that our entomologists must learn to talk more about the problems of the forests and the trees. Too long, they have been involved with the insect without understanding the host. If the insect dynamics change, how does that change relate to its host's physiology? This information will help the entomologists give better advice to the forest manager.

The use of biotechnologically sophisticated techniques to improve resistance to insect and diseases in plants, and understanding them is essential, as is the use of similar sophisticated methods that may help the entomologists to alter the insects themselves.

The challenges are there!!

- John Fulkerson, Cooperative State Research Service, USDA, Washington, D.C. In 1975, pioneering experiments were conducted that have provided the foundation for the present revolution in molecular biology. Concommitantly during this period enormous surpluses of forest and agricultural products occurred in the U.S. In spite of this economic situation, the U.S. government provided huge increases in research budgets to pursue the development of biotechnology. A group of plant breeders went to Washington to lobby for greater support for their research. Legislators were not impressed with the "relative poverty," "big vs. small," or "increased or sustained productivity" arguments. The collaboration between universities and industry to produce new technology, i.e., genetic engineering, was the successful selling strategy for molecular biology. The last increase in support of forest entomology went to molecular biology.

Epilogue - Copies of the summaries from this workshop were forwarded to Professor Arthur Kelman, Department of Plant Pathology, University of Wisconsin, Madison. With assistance of members of the Forest Pathology Committee of the American Phytopathological Society, he is assessing the current status of support for forest pathology in the U.S.A. as compared to the previous two decades. Professor Kelman is a member of the National Academy of Sciences Council, which is the major policy body of the NAS. Copies were also sent to Professor Fred Hain, Department of Entomology, N.C. State University, who led a similar discussion at the annual meeting of the Southern Forest Insect Work Conference in August 1987. Forest entomologists need to join with other forest biologists, i.e., ecologists, pathologists, physiologists and geneticists, and determine the best approach for protecting and enhancing our disciplines that support forestry. At the same time we need to elicit support from the forest resource community.

PANEL: VEGETATION MANAGEMENT

MODERATOR: David G. Holland

PANELIST: George Gruell, Russ Cozens, John Laut

THE ROLE OF FOREST INSECTS AND DISEASES / VEGETATION MANAGEMENT
DAVID G. HOLLAND

Our forested lands are a dominant geographical feature of western North America and provide habitat for wildlife, forage for livestock, protective cover for watersheds, timber for a variety of uses, and the natural backdrop for outdoor recreation and aesthetic enjoyment. Management objectives and priorities for these forested acres are as diverse as the people using the resource. Competing demands for the goods and services these areas can produced significantly influence the managers' perceptions of the values at stake.

A forest stand is a product of forest succession, a dynamic process within the forest ecosystem. For management purposes, forest stands are classified as forest types according to their current composition and the predominant tree species present, or in terms of habitat types. Changes in habitat characteristics due to insect outbreaks are considered essentially random events by many resource managers. Generally, the effects of pests are excluded from consideration as an integral part of the ecosystem, when in fact they might be the determining factor in the current character and successional pattern of the forest ecosystem. Periodic events such as insect outbreaks and wildfires have considerable influence on the evolution of forest ecosystems(Bormann and Likens, 1979). For example, lodgepole pine seldom becomes the climax stand in an area without the intervention of some event that permits the continuation of the species. Long fire intervals tend to elimate lodgepole pine.

Disturbances due to forest pests affect the complexity and uncertainty of current management assessments and future plans. These agents can be particularly disruptive to ongoing management activities. The exclusion of fire by man has altered the condition of the forest, resulting in extensive pest infestations. These infestations are much larger in area than those of the past because of the present "old growth" condition of the forest. Historically, fire created mosaics of forest vegetation with a wide distribution of age, species diversity, and size. These mosaics usually prevented the large insect and disease infestations we observe today.

Forest resource management is a long-term process. To be an effective part of it, pest management must be conceived and organized on the same basis. The management scheme must be structured and designed to allow realistic integration of pest occurrence, effects, and treatments with the dynamics of

forest stand growth and management objectives. The issue at hand is not how much and when forest pests will affect management opportunities, but what the objectives are for a specific forest area. If managers can describe the desired future condition of the vegetation, they can decide what actions are required to achieve thier goals.

For example, during a recent review of timber management activities on a Forest in the Intermountain Region, a primary objective expressed was to maintain cover for big game. The public and wildlife interests wanted to maintain entire drainages in the present forest cover, which is mostly "old growth" trees. Holding old growth stands indefinitely, without planned regeneration of the stands, is totally unrealistic.

These forests are part of a dynamic, ever-changing ecosystem with a kaleidoscope of changing vegetation, a myriad of insects and diseases, and historic fire regimes. To maintain these forests as they are today is totally unrealistic. In areas not designated for timber harvesting, fire should be reinstituted into these ecosystems. Fire management plans should be designed for these areas integrating forest succession, insect and disease dynamics, and fire ecology. Holding existing stands results in widespread incidence of mountain pine beetle, spruce budworm, dwarf mistletoe, and other pests. In many forests, lodgepole pine has been replaced by the more tolerant spruce and fir, and even these species are dying and falling to the ground creating surface fuels that will eventually burn, usually under rather severe fire weather, and with catastrophic results.

Society in general has difficulty in choosing long term over short term benefits. We need to recognize long term implications of meeting short term management objectives. Minimizing the impacts of forest pests on forest resources requires careful consideration of short-term and long-term objectives to determine the most economical and silviculturally sound alternatives. Forest pests have been and are a natural mortality factor; and in some cases, as with lodgepole pine and mountain pine beetle, they are the primary mortality factors, regardless of efforts to manage the land. Objectives for manipulating these pests should use the natural ecological processes to our advantage. As managers and users of the ecosystem, we must develop vegetation management plans which promote stand structures, compositions, and conditions designed to enhance the vegetal diversity and account for the successional potential of the site. Without such action, forest pests will continue as regulators of unmanaged vegetation.

ABSTRACT
38TH WESTERN FOREST INSECT CONFERENCE

INFLUENCE OF FIRE ON PLANT SUCCESSION

GEORGE E. GRUELL

Research has demonstrated that fire played a major ecological role in the development and growth of vegetation over thousands of years. In forested ecosystems, the frequency of historical fires has been determined by study of fire scarred trees. These studies reveal that fires were frequent in warm-dry ecosystems, while cool-moist ecosystems burned infrequently.

Fire's influence on vegetation was drastically reduced following Euroamerican settlement. Factors responsible included the removal of fine fuels by livestock, elimination of Indian ignitions, and organized fire suppression. The reduction or absence of fire has contributed to a massive increase in growth of woody vegetation.

Advances in vegetal succession have resulted in a decline in the productivity of various resources. For example, there has been major losses of conifers to insects and disease, livestock forage has declined significantly because of competition from woody vegetation, early and mid-successional wildlife habitats are in short supply, scenic quality has declined in forested environments because of reduced viewing opportunities, recreation access has been diminished, water production has declined due to heavy evapo-transpiration by woody plants, and the threat of large wildfires has increased greatly because of massive buildup of both dead and live fuels.

We occuppy a fire prone environment that supports fire adapted, often fire dependent plants that require periodic disturbance for successful regeneration. Recognizing the need for fire disturbance, the Forest Service is applying prescribed fire in various ecosystems for purposes of enhancing resource productivity. Sagebrush has been burned for purposes of increasing production of livestock forage. Bighorn sheep habitats have been improved by removal of conifers through application of prescribed fire. Use of prescribed fire in non-commercial conifer/aspen has resulted in new stands of aspen and increased diversity that meets the habitat needs of mule deer, elk, and other wildlife. Underburning of ponderosa pine has reduced susceptability of stands to crown fires, while enhancing opportunities for establishment of pine seedlings, and increasing forage for livestock and big game.

Increased awareness of the ecological rational to disturb vegetation by cutting and application of prescribed fire will result in improvement of resource values over the long-term. Vegetation is dynamic, it changes over time. Resource managers have a challenge to manage vegetation in a sound, professional manner to meet the future needs of society.

Vegetation Management -- The Key to Enhanced Forest Performance Through Insect Pest Management

Russel D. Cozens

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SUMMARY

Vegetation management practices are critical in the development of a new forest. While traditionally associated with activities leading to enhanced tree growth, cultural practices can be followed to mitigate the influences of forest insect and disease activity upon the crop.

Effective prevention of pest damage through silvicultural pactices must begin long before a stand is harvested or a pest population is found to be threatening a forest. A risk and hazard rating of the management area will prove to be a valuable asset in the development of co-ordinated forest management plans. A carefully developed risk and hazard rating system can be used to ensure that conditions will not be created that will be conducive to pest activity and development such that damage exceeds pre-determined economic or other thresholds.

Various insect pests lend themselves ideally to the approach of management guided by risk and hazard ratings. The impacts of the black army cutworm, a defoliator of freshly planted seedlings, can be successfully be managed once the groundwork has been done. A mild controversy over the effects of the removal of a deciduous overstory and the relative effects upon the growth of spruce trees and the activity of spruce weevil may be resolved by such an approach. Spacing and thinning of thrifty-mature stands can be guided by a knowledge of the pest activity relative to the conditions created by our cultural activities. Harvesting must be guided not only by economics, but by the state of the stand with respect to its health and general well-being.

Vegetation management programmes must be developed and instituted with sound ecological practices as their base. The ecological approach can be used to develop risk and hazard ratings for each stage of forest development. By observing the ratings, and the conditions favourable to a pest outbreak, the forest manager can conduct silvicultural treatments to not only increase tree growth, but reduce the chances of losses to pest activity.

Workshop: Use of Silvicultural Practices to Control Insects in Vegetation Management Programs.

Moderator: Barry Bollenbacher, District Silviculturist, Swan Lake Ranger District, Flathead National Forest, Montana.

Participants: 30

The primary discussion revolved around silvicultural treatments in response to the Mountain Pine Beetle in ponderosa pine and lodgepole pine located in the western United States and Spruce Beetle in Alaska on the Chugach National Forest. In relation to the Mountain Pine Beetle, discussion of silvicultural treatments centered on sanitation--thinning strategies to reduce losses from MPB in older 60-125 year old stands of LP and PP. Data from Region 1, 2, 4, and 6, of the U.S.F.S. was presented for discussion. The general concensus was that reducing the basal area of older stands down to 80-100 square feet from a pre-treatment level of 130-200, reduces subsequent mortality of the leave trees to acceptable levels in many cases. Leave trees were selected from the largest and most vigorous in the stand. This treatment option can be very useful if management objectives involve a concern for diversity of age class and their distribution. For management objectives, which include wildlife, watershed, visual resource, and long-term management of LP and PP in connection with the MPB, thinning treatments can be quite useful especially if the amount of area that can be regenerated in any one decade in a local area is limited.

Discussion also included the reasons for the beetle response to the thinning treatments. The following were hot discussion items:

1. Micro climate change within the stand.
2. Increased vigor of the leave trees.
3. Change in the relative production of various terpene alcohol production in the leave trees.
4. Soil nutrient availability.
5. Disease factors such as Armilania, Commander rust, and mistletoe.
6. In some locations in Region 6, this treatment option failed.

It was suggested by many present, that investigation into the reasons behind the beetle response should be continued,to aid in the future understanding of MPB interactions with the host material.

Also under consideration by the group was the Spruce Beetle on the Chugach National Forest in Alaska. Again, due to very restrictive other resource concerns, such as the visual resource along major highways, stand structures need to be developed that include continuous forest cover with basal areas low enough to discourage epidemic buildups of Spruce Beetle. The selection or group selection silvicultural harvest system was prosposed for this situation. In utilizing this system, basal areas could be kept within a range where unacceptable losses associated with high density un-managed old growth stands, could be reduced while meeting visual management goals.

In summary, the session reviewed some technical aspects of Silvicultural treatments in relation to Insect control and management. The session also reinforced the need for coordination between research entomologists and the field application by entomologists and silviculturists implementing strategies to limit the impacts of bark beetles.

WORKSHOP: ROLE OF FIRE IN INSECT ECOLOGY AND ITS USE IN VEGETATION MANAGEMENT PROGRAMS

Moderator: Bob Gara

Participants: E. Nebeker, S. Cook, L. Safranyik, J. McLean, D. Parmeter, F. Baker, G. Amman, F. Hain, G. Gruell, J. Logan, M. Wagner, B. Coulson, D. Wood, C. Ohmart, M. Jenkins, K. Hobsen, D. Dahlsten, D. Mason, H. Kulman, A. Berryman, J. Neisess, S. Gast, D. Bartos, L. Wadleif, A.Keyor, S. Cameron, D. Hrynyshyn, J. Moser, T. Schowalter.

Gara opened by summarizing interactions among fire, disease and mountain pine beetle which contribute to perpetuation of lodgepole pine in lodgepole ecosystems. MPB attacks fire scarred and butt-rotted trees. Proposed model: stand replacement fire kills pines, and allows sufficient soil moisture for regeneration. Increasing competition with growth promotes tree death through factors of suppression. Partial decomposition of accumulating fuels leads to smoldering fire that spreads from log to log leaving fire tracks, scarred trees and scarred roots. Fungal infection through root wounds is caused by the smoldering fire. Rotted trees grow more slowly and some 70 years later these trees serve as foci for dispersing MPB. In fact, it was found that beetles landed on scarred or rotted trees significantly more often than on unscarred, unrotted trees. Once a major outbreak is generated, fuels accumulate rapidly, setting the stage for the next stand replacement fire. The mechanism may be different in other areas where fire scars are less numerous or obvious.

Discussion revolved around the importance of stress or chemical attraction resulting from rot. Butt rot could be present without fire scarring. Coulson noted that Schowalter, Coulson et. al. suggesting that lightening strikes also generate focus trees. Time of lightening strike or other disturbance strongly affects attractiveness to insects. Resin chemistry changes as a result of lightening.

Gruell noted value of prescribed burning in suitable areas, but stands in which fire-scarring would generate focus trees should not be burned.

Cameron showed figures for frequency of SPB spots by stand (plantation) age: infestations occurred as early as 6 years and increased though 15 years. More (at least 2X) SPB spots occurred in burned stands of all ages, relative to unburned stands. This frequency was unchanged for stands burned up to 3 years before 1985. Perhaps fire management focuses on stands with higher fuel or SPB likelihood. Burn effects could last longer than 3 years. Burning may not be appropriate in all areas. Other insect species my respond in unpredictable ways.

Frequency of fire also may be important. Schowalter noted that fire tolerance depends on tree age, and the value of prescribed burning for vegetation management may decline as competing plants grow out of a fire window.

WORKSHOP: USE OF SEMIO-CHEMICALS TO MANIPULATE INSECTS IN VEGETATION MANAGEMENT PROGRAMS
MODERATOR: PETER M. HALL
PARTICIPANTS: MORE THAN 24 ATTENDEES

Discussion of the use of semio-chemicals for population monitoring purposes was minimized as much as possible as this particular use pattern is both acknowledged as important and would warrant an entire workshop session itself. The assumption was made that an adequate chemical existed and then the possibilities of managing an insect population using it in a variety of patterns was addressed.

Dr. Gary Daterman presented information regarding the use of semio-chemicals for management of defoliator pests. Defoliator management was illustrated by examples with Douglas-fir tussock moth, western spruce budworm, and pine shoot borer. Mating disruption was the primary technique that has been assessed. Trials of this technique have shown considerable promise in reducing damage levels, particularly for tussock moth and pine shoot borer. Results have been less satisfactory for western spruce budworm. Management through mating disruption appears to be most feasible when applied in the pre-outbreak phase, possibly (in relation to tussock moth) even before the insertion of virus would be considered. Further evaluation of the course of an outbreak subsequent to disruption is required to determine if the treatment has carry-over effects. Mating disruption appears to have promise as an alternative to traditional direct treatments, but is predicated on an effective monitoring and predictive program. Further, registration of these products for such purposes may be required prior to operational use.

Dr. Steffan Lindgren discussed aspects relating to bark beetles. Use of aggregation and anti-aggregating chemicals for bark beetles has become a viable management tool. At present, aggregating semio-chemicals are considered to be operational in both Canada and the U.S.; however, the registration status of these agents has to be resolved in the U.S. before implementation can occur. This issue is also of potential concern in Canada.

As opposed to mating disruption in defoliator pests, the use of semio-chemicals in beetle management does not, in itself, provide loss reduction. Rather, the use of such agents makes survey, single tree, and harvesting operations more efficient in reducing subsequent levels of attack. Reductions in survey time and long distance beetle dispersal allows normal beetle-directed operations to more adequately address resident pest populations.

Semio-chemicals represent an ideal opportunity to manipulate pest populations to allow managers to meet their objectives. When used in conjunction with other forest practices, they may allow more effective treatment and greater protection of the resource at comparable cost to alternatives. Registration and other legal and operational constraints must be addressed and resolved in the near future.

WORKSHOP: Use of Chemical To Control Insects in Vegetation Management Programs

MODERATOR: Jesus A. Cota

PARTICIPANTS: A total of 11 conferees participated in the workshop

Little information is currently available on the use of chemicals to manipulate insect populations in programs where the objective to manage vegetation. For this reason, the discussions of the workshop centered around short presentations of the results of field projects where biological and chemical insecticides were used to control insects. The following presentations were made:

1. Use of Bacillus thuringiensis for the protection of seed production in trees being attacked by the western spruce budworm Choristoneura occidentalis. Treatments were conducted in 1986 with mortality of the budworm population being about 90 percent. Population density in early 1987 was less than 7 larvae per 100 buds therefore negating the need for treatment during that year.

2. Application of the nuclear polyhedrosis virus (TM-Biocontrol) for suppression of populations of the Douglas-fir tussock moth Orgyia pseudotsugata. This project encompassed 33,000 acres but only 900 and 2,000 acres were treated with the virus in 1985 and 1986, respectively. An interesting note is that the amount of virus recovered in soil samples from treated areas continued to increase even though no spraying was conducted in 1987. Little or no virus was recovered in soil samples taken from the Check areas.

3. Planned activities for the 1987 operational suppression project in Region 6 to control the western spruce budworm with B.t. The Region was allocated 4.5 million dollars to treat over 300,000 acres of budworm infested forest. Discussions centered around the projections of budworm damage made with the Prognosis Stand Yield Model.

4. Use of Acephate implants for protection of selected seed producing trees. Objective of the project was to determine the difference in protection between fall and spring placement of acephate implants. Results indicated no significant difference in protection between the two treatment times with fall treatments showing a savings of about 10 dollars per tree.

PANEL: Advanced Technology in Forest Management

MODERATOR: William B. White

PANELISTS: Robert Coulson, Robert Acciavatti, and Charles Dull

MODERATOR INTRODUCTION

Presentations under this topic could not cover the full spectrum of technologies that can be applied to forest management: computers, telecommunications, information systems (spatial and tabular), remote sensing, and artificial intelligence. Three technology applications from the above list, artificial intelligence, remote sensing, and geographic information systems, were selected for expanded coverage by the three panelists (summaries follow). Panelists were requested to present how applications within one technology area could be supported by or support another application.

In closing the session the moderator highlighted Resource Technology 88, an International Symposium on Advanced Technology in Natural Resource Management. The theme of the Symposium is that of technology integration - the integration of selected technologies that produce a synergy. The integration of technologies stressed during the panel presentations is the approach that will carry forest management into the 90's and beyond.

NASA High Altitude Reconnaissance Aerial Photography for Mapping Gypsy Moth Defoliation in the Northeastern United States

Dr. Robert E. Acciavatti
USDA, Forest Service, Northeastern Area,
Forest Pest Management Staff
Morgantown, WV 26505

Since 1981, the USDA, Forest Service, on behalf of several northeastern States, has utilized the high altitude reconnaissance aerial photography capablities of NASA to locate and map gypsy moth defoliation. Four multi-state aerial photography projects during this time period, have demonstrated the technology as an accurate, cost effective complement to the standard aerial sketchmapping techniques for detecting and mapping two severity classes of gypsy moth defoliation. In addition, the efficacy of aerial spraying against this major forest defoliator can be readily evaluated. Where gypsy moth outbreaks have subsided naturally, the resultant tree mortality can be reliably assessed with these photographs.

The latest project during 1986 provided typical information about the application of this technology. NASA-ARC high altitude reconnaissance aircraft, using an Itek IRIS II optical bar camera, obtained panoramic color infrared aerial photographic coverage of 27,473 sq.mi. in Delaware, Maryland, Pennsylvania, and Virginia, on June 22 and 25, and July 4, 1986. Photo aquisition was arranged by USDA Forest Service, NFAP, Salt Lake City, UT. The film was processed by the EPA-EPIC, Warrenton, VA, and by July 25, had been delivered by the USDA FS, FPM, to its cooperating State agencies in the photo mission area. The photos were purchased at a cost of $56,875 and used by the State and Federal agencies responsible for detecting and mapping gypsy moth defoliation, and for evaluating the efficacy of aerial insecticide spray projects against gypsy moth infestations.

ABSTRACT

WORKSHOP: ADVANCED TECHNOLOGY PANEL
Moderator: Bill White

TITLE: ASSESSMENT OF TIMBER MORTALITY UTILIZING REMOTE SENSING AND GIS TECHNOLOGIES
By: Charles W. Dull

Foresters, resource managers, and entomologists manage a tremendous amount of information concerning natural resources. A great deal of data may be collected through aerial photographic surveys, sketchmap surveys, ground surveys as well as satellite images which pertain to geographic locations. Managing this data at times can be a tremendous burden on professional resource managers. One of the more efficient ways to manage and link this data to geographic locations involves the utilization of a geographic information system (GIS).

The U. S. Forest Service, Forest Pest Management Staff, in Atlanta, Georgia, is currently using the Map Overlay and Statistical System (MOSS) to manage and analyze resource information. MOSS is composed of a set of software for encoding, transforming, analyzing and displaying maps and other geobased information. The MOSS system is composed of three components: a digital data entry system; the GIS itself for data processing, analysis and display; and the Cartographic Output System (COS) for enhanced plotting capabilities. The primary functions of this GIS provide for descriptive analysis of map data sets and for the generation of new data sets by transformation of existing maps. These functions are used to reclassify maps, overlay maps, measure cartographic distances and characterize cartographic neighborhoods. Many functions are available to calculate area, distance, perimeter, length, frequency, descriptive statistics, and location coordinates. The geographic data base can be plotted and projected in one of twenty available map projections.

Four different projects utilizing GIS to assess timber damage were briefly discussed as follows:

1. Assessment of spruce fir mortality in the Southeast.

2. Evaluation of gypsy moth defoliation in Virginia.

3. Development of a GIS to evaluate control efficacy of the southern pine beetle in Texas.

4. The design and pilot test of a long-term monitoring study of eastern United States forests for response to atmospheric deposition.

Methods for collecting and analyzing information for each of these projects utilizing a GIS were discussed. The use of a GIS for research purposes in the development of cartographic models, as well as operational management activities to determine what relationship damage causing agents may have on forest conditions and their geographic positions as determined by a GIS, were reviewed.

FIELD TRIP: VEGETATION MANAGEMENT AT PARK CITY SKI AREA
TRIP LEADER: Michael J. Jenkins

11 participants

The objective of ski area management is to provide healthy trees enhancing the recreational experience. This was the general theme discussed during a half day field trip conducted on skis at the Park City ski area.

It was suggested that ski areas have biotic and visual impacts and it is the role of the landscape architect to decrease the impact of people on the environment and to maintain the benefits to watershed, soil, and wildlife.

Trees growing at ski areas have values different than those commonly considered in forestry. Among these values are slope stabilization for avalanche control, shade for snowpack protection and effects on snow deposition. Trees are important in separating runs, providing wind blocks to decrease wind scour and to provide for optimal skier circulation.

Any pest attacking and killing trees decreases these values. Pests identified as important in Rocky Mountain ski areas included mountain pine beetle, western spruce budworm, spruce beetle, dwarf mistletoes and root rots. Several of these pests were identified at Park City during the tour.

There was some discussion of constraints affecting removal trees killed by pests. These constraints included access, environmental restrictions, lack of markets for timber, and negative visual impacts of slash associated with logging. The removal of any tree creates openings accessible to "tree bashers" who seek powder in even the smallest openings. The value of the computer program "Perspective Plot" was discussed as a useful tool for visualizing the impact of various logging strategies.

Reforesting areas logged to remove pest-attacked trees was also discussed. Reforestation has long been used in Europe for avalanche control, but has not been widely considered in North America. A major difficulty in reforestation in ski areas is in protecting the regeneration from skiers. It was suggested that slash be left to protect seedlings, but that has the negative visual impacts in areas also valued by summer sightseers and hikers.

There were several in the group who felt that the major pest affecting vegetation management programs in ski areas is the skier.

Everyone in the group recognized that vegetation management in ski areas will become increasingly important as overmature, trees typical of ski areas, become attacked by pests. Examples were cited of the problem with mountain pine beetle in certain Colorado ski areas and the dwarf mistletoe situation at Sun Valley in Idaho.

WORKSHOP: INTERACTIVE VIDEODISC
MODERATOR: Michael J. Jenkins and two graduate assistants

8 participants

Interactive videodisc technology was described as a powerful educational medium combining computer assisted instruction (CAI) and high quality video imagery. By interactive we mean that a dialog exists between the learner and the instructional program allowing the learner to intervene and make decisions about the lesson content and delivery. The learner is able to control the pace, style, scope, sequence, and duration of the instruction.

The application of interactive videodisc technology to industry, medicine, sales, and in visitor centers was discussed.

The group was interested in the design of videodisc instruction. The moderator described that the instruction in modular, not linear as in traditional instruction. The major challenge of designing videodisc instruction is in integrating the various media and creating a dynamic relationship between the user and the system. It is branching that makes this possible. Branching is represented by a flowchart which depicts all of the instructional events and results in the production of scripts and storyboards used by the programmer to create the computer screens.

The application of this technology to natural resources was discussed in relation to the fire behavior project that the moderator is working on.

Following his general discussion a demonstration of the fire behavior program was given by Chris Larsen, Instructional Technology graduate student at Utah State University.

The session ended with considerable discussion concerning the application of the system to Forest Pest Management training including various delivery system options.

WORKSHOP: Geographic Information Systems (GIS)

MODERATOR: Bill White

Participants: Fifteen WFIWC Members

A quick survey of participants revealed that two-thirds in attendance did not have even a basic understanding of GIS. The remaining one-third were quite familiar with them, even to the extent of being instrumental in acquisition and operation at various locations. Based on the wide gap in knowledge relative to GIS, the moderator divided the session into three phases: 1) An introduction to GIS; 2) GIS ongoing applications; and 3) future GIS applications.

Introduction to GIS - The moderator and the other knowledgable participants pooled their resources to explain the basic concepts of geographic information systems.

Ongoing Applications - The moderator called upon several individuals to discuss various GIS projects and applications:

Andy Knapp, USDA Forest Service, Forest Pest Management, Boise, Idaho:
Andy discussed the Region 4 mapping system (GIS) used by FPM personnel to replicate aerial detection survey maps and compile previous and current pest data.

Ann Lynch, School of Renewable Natural Resources, University of Arizona:
Ann discussed what the University of Arizona had underway with respect to education and GIS.

Chuck Dull, USDA, Forest Pest Management, Atlanta, Georgia:
Chuck described ongoing activities relative to the Southern Region's GIS-MOSS (Map Overlay and Statistical System). (See Chuck's summary under Advanced Technologies in Forest Management, this Proceedings.)

Bill White, USDA Forest Service, Methods Application Group, Fort Collins, Colorado:
Bill presented how a natural resource management support system (Figure 1) had taken GIS operations and imbedded them into a user friendly computer environment; thus freeing the user from being an expert GIS user.

Future GIS Applications - The moderator closed the session by discussing an integrated application of a GIS. The particular project used as an example was "Automating Integrated Resource Management on the Nicolet National Forest, Wisconsin". The subject project will integrate the Forest's GIS/MOSS, various resource data bases, simulation models, and expert knowledge, via an expert system, into one resource support system.

The session was closed with a question and answer session.

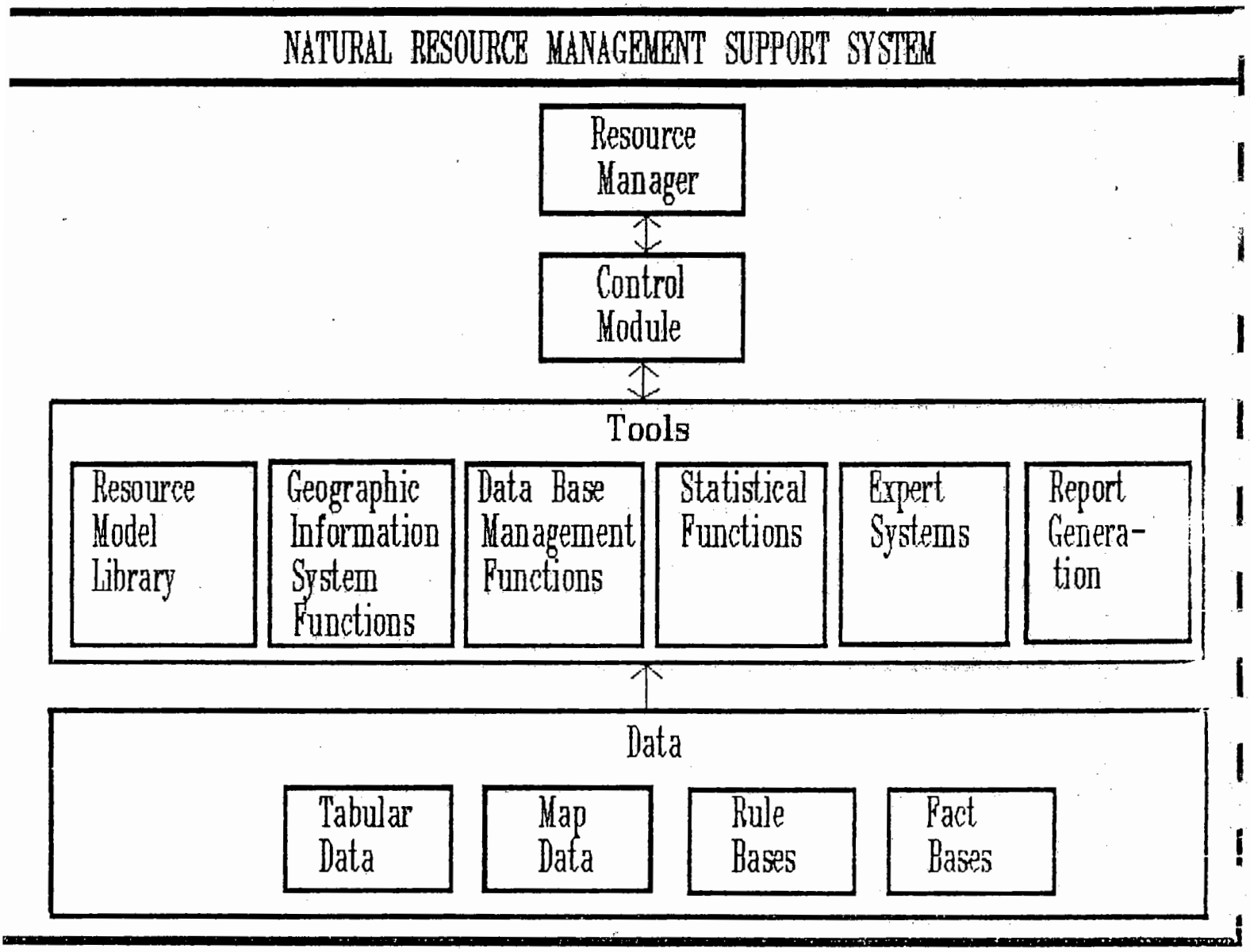
NATURAL RESOURCE MANAGEMENT SUPPORT SYSTEM
Resource Manager
Control Module
Tools
Resource Model Library
Geographic Information System Functions
Data Base Management Functions
Statistical Functions
Expert Systems
Report Generation
Data
Tabular Data
Map Data
Rule Bases
Fact Bases

FIGURE 1

WORKSHOP: Artificial Intelligence and Expert Systems
MODERATOR: Jesse A. Logan
Participants: 37 registered

This workshop session centered around applications of expert systems rather than the somewhat broader topic of artificial intelligence. Much of the discussion was a continuation of that started in the morning panel, High Tec Applications in Forest Pest Management. Robert Coulson, in particular, was able to provide the lead in a discussion about the technical aspects of expert systems development and the application of this technology in forest pest management. From this discussion it became apparent that expert systems technology is a new approach that differs from previous user-friendly computer programs in that (1) true expertise is exhibited by the program (2) decision making is a part of the program (i.e. the inference engine), and (3) a wide array of new tool have become available that assist in capturing human expertise.

In general, workshop participants seemed to be optimistic about the potential role of expert systems in the forest pest management decision process. Participants seemed to agree that there is a lot of good information that at the present time is not readily available to the people (either in industry or government) who make decisions and establish policy. Computer simulation models are a good example. Often models require data in a form that is not readily available, the model may be difficult to access and/or run, etc. Expert systems were seen as a way to make these sources of knowledge more readily available. It was also noted that there is often a lack of communication between real human experts. Expert systems were perceived as a way to both broaden the data base used in reaching policy decisions and as a way to facilitate interaction between discipline experts and the people who establish policy.

Although the general feeling was one of optimism, it should be noted that this optimism was based on the perceived potential of expert systems and not on demonstrable application. The technology is simply too new to have established much of a track record, either good or bad. Several people, however, expressed concern about the appropriateness of turning over important decisions to a computer program. Expert systems were seen by some to be a way in which policy makers could abdicate responsibility for controversial decisions. Caution was also voiced about unrealistic expectations for this technology. I think everyone was in agreement that expert systems should not be viewed as the new "silver bullet."

WORKSHOP: REMOTE SENSING
Moderator: C.J. DeMars,Jr.
Participants: Twenty-five individuals attended this session with four individuals making presentations.

The goal of this workshop was to present the program of training and special project support that the U.S.D.A. Forest Service's Nationwide Forestry Applications Program (NFAP) at Salt Lake City can provide to forest pest management researchers and practitioners in the use of standard 9x9 and special format aerial photography for detecting and evaluating insect and disease problems.

F.P. Weber is program manager of this unit which has two projects, training (Henry Lachowski, P.L.) and special projects (Jerry Greer, P.L.). Henry gave an overview of the training function which includes a variety of one day to four day courses taught by Jule Caylor, Mike Hoppus and James Ward. Topics that are covered include basic and advanced photointerpretation of standard (9x9) resource photography, vegetation mapping from small scale (1:32,000 - 1:64,000) color infrared photography, utilization of panoramic optical bar photography, and other special courses tailored to the needs of the users. James Ward described a photo interpretation manual being prepared for use by Forest Service Units.

Paul Ishikawa described the special projects currently underway which include:

Survey of oak decline in Texas.
Survey of spruce decline in Northeast USA.
Raparian mapping on the Big Horn N.F.
Port-Orford cedar inventory.
Plantation stocking and survival analysis.

Jule Caylor presented some guidelines useful to managers in selecting the appropriate kind and scale of photography to do particular jobs, indicating clearly that there is no universial type (film) or scale that will adequately and efficently do all jobs. A user needs to clearly define what he or she needs to detect, evaluate, delineate, or measure for their particular purpose and to select the imagery to do that job, or if required to use existing photos, to know the limitations that are inheirent to that scale and film type.

A discussion followed of the possibility of using aerial photography for several different biological studies and the most appropriate kind of imagery for the task.

For additional information, interested persons may contact Phil Weber:

USDA Forest Service
Nationwide Forestry Applications Program
2222 West 2300 South
Salt Lake City, UT 84199
(801) 524-4580
FTS 588-4580

WORKSHOP: Hazard Rating for Insect Infestations
MODERATOR: Terry Shore
PARTICIPANTS: 18

The initial discussion focussed on the difference between hazard and risk and what factors should be included in hazard and risk rating systems. There was some agreement that these terms could be used in the same sense as they are with respect to fire: hazard is a measure of the quantity and condition of the fuel and risk is a measure of the probability of ignition. There was less agreement, however, on what stand, site and insect factors should be included in hazard and risk rating systems, or indeed if they can be separated into two systems. Factors such as climate, weather and measurements of stress can be considered components of either or both of hazard and risk rating systems.

Another topic discussed was "what can and can't a hazard rating system do for you". Discussion centred mainly on whether or not a hazard rating system that is based on variables that require special effort to collect will be used and whether or not it is necessary for the system to be understandable to either the researcher or user in a biological sense. I think the majority felt that a system would not be well utilized if it required much special data collection (i.e. additional to that collected during routine forest surveys) and that as long as a system worked it was not necessary to fully understand why. However, the point was made that a system based on understandable site and stand parameters has the advantage of providing the forest manager with variables which he may be able to manipulate through various management strategies to reduce his hazard level.

Finally, a short update on the evaluation of several hazard rating systems for the mountain pine beetle in lodgepole pine was presented by John Anhold and Gene Amman.

WORKSHOP: RECENT TESTS OF BARK BEETLE SEMIOCHEMICALS
Moderator: Mark McGregor
Participants: 32

Art Stock discussed current research of Pheromones for management of Western balsam bark beetle. Exo-brevicomin is attractant and Endo-brevicomin is antiaggregative pheromone. Felled -tree tests using both pheromones are planned for 1987. Tree mortality from this bark beetle has greatly increased in British Columbia the past five years.

Richard Schmitz discussed 1986 field tests of Verberone, Racemic and Enantiomers of Frontalin and Ipsdienol for MPB associates. Verberone terminated attraction of MPB. Tests were done using Lindgren Funnel Traps. Frontalin and Ipsdienol field test data were not yet analyzed. Additional field tests are planned for 1987 season.

Staffan Lindgren reported on development of strategies using baited Lindgren Funnel Traps for trapping Douglas-fir beetles in small infestations. Data from Wyoming and Utah indicate serious spillover into adjacent trees, indicating beetles may not be responding to the same pheromones as populations in Montana and British Columbia as spillover is minimal in these areas. Additional field tests are planned for 1987.

New pheromones have been identified for Spruce beetle and mountain pine beetle and will be field tested in 1987.

Tom Phillips discussed field tests of various pheromones against Pales weevil, Sawyer beetle, two ambrosia beetles and Black Turpentine beetle. Indicated that various pheromones combinations and ethanol produced good catches for some ambrosia beetles and pine sawyer. Frontalin and terp caught more males of Black Turpentine beetle, and Endo-brevicomin and Terp had higher response of females. Additional tests are planned for 1987.

Ron Billing discussed use of Lindgren Funnel Traps in determining southern pine beetle trends by numbers of clerids caught. Trend predictions for some areas were accurate and additional tests over more southern states are planned for 1987.

Tom Payne discussed use of tree baits in management of southern pine beetle spot infestations. Baited trees were felled resulting in brood mortality. Baiting poor brood trees plus verberone resulted in brood reduction. Tests are planned using several pheromones in enantiomeric forms in 1987.

Workshop: Insect - Tree Disease Interactions
Moderator: Fred Baker
Particpants: 32

John Moser presented recent findings that Ceratocystis minor is apparently transmitted by mites on southern pine beetle, rather than by the beetle itself. This phenomenon needs to be examined in other systems. Questions were raised whether the stain fungi might interfere with the growth of mycangial fungi. Fungi may benefit the beetle, as in the case where southern pine beetles carrying a basidiomycete were larger and emerged more quickly than beetles carrying a more aggressively pathogenic Sporothrix.

There was discussion of the association of root disease fungi with endemic infestations of mountain pine beetle. In the Black Hills and in some stands in Utah and Wyoming, trees attacked by mountain pine beetle at endemic levels had Armillaria root disease. Trees attacked by spruce beetle in Utah had Armillaria or Inonotus tomentosus on their roots. Root diseases did not seem to be associated with endemic spruce beetle infestations in northern Idaho. Lessard reported extensive mortality caused by bark beetle - Armillaria on high elevation, wet sites, but low mortality on lower, drier sites. These situations were discussed in the context that it was not possible to "beetle proof" a stand by thinning, because the root rot stressed the remaining trees and the beetles returned. The need to evaluate hazard to pathogens when considering beetle management was recognized. Thinning also increases the incidence of Verticicladiella = Ceratocystis in California and in Oregon. Thinning apparently attracts the beetles (Hylastes, Pissodes, and Steremnius) vectoring the fungus. Thinning after the beetles primary flight period attracted fewer beetles than thinning the 6 months before.

Discussion then turned to the pine wood nematode. Marc Linit reported that nematode transmission during maturation feeding resulting in mortality was associated with exotic or off site species, while the nematode was transmitted during oviposition by cerambycids in declining native conifers.

John Foltz provided some "encouraging" information about insects and diseases associated with an experiment where slash and loblolly pines in Florida were provided fertilizer, weed control, and irrigation. Tip moth and pitch canker were associated with loblolly pine, pitch moth and pitch canker were associated with fertilized slash pine fusiform rust, pitch moth and pitch canker with maximum growth slash pine, pitch canker, freeze damage, and Pityopthorus were associated with loblolly pine, and mites were abundant on dry plots.

WORKSHOP: DEFOLIATORS
Moderator: Dick Mason
Participants: 21

The topic was introduced via the hypothesis that vertical processes are more important than horizontal ones in defoliator communities, i.e. the major processes work vertically across the trophic levels of plants (producer), defoliators (consumer), and natural enemies (secondary consumer) rather than horizontally as interspecific competition. The success of a defoliator species is determined by: (1) foliage of the host tree through the chemistry of nutrition and defense, (2) parasites, predators, and disease, and (3) external factors. S. A. Graham in his 1952 edition of Forest Entomology implicitly recognized the importance of these factors and believed they could be optimized indirectly by managing stands for a diversity of age-classes and tree species. He believed that insect problems in general could be minimized by intelligent use of "the axe and the saw." A question was posed as to whether it is still practical to believe that the upper and lower trophic levels can be managed to reduce defoliator problems.

In the discussion of explicit factors that followed it was brought out that, contrary to some hypotheses, defoliators are seldom limited by a shortage of N in the foliage. Controlled laboratory rearings of western budworm also do not respond consistently to simple changes in N. Other nutrients are obviously important but in unknown ways. The influence of foliage may cross more than one trophic level as illustrated by a recent finding that susceptibility of tussock moth larvae to virus disease may be related to foliage source. Although defensive compounds are present in host foliage at varying quantities, their effect on the population dynamics of defoliators is still vague and difficult to evaluate by life table analysis. Natural enemies such as birds prey on a significant proportion of individuals in each generation of many defoliator species, but little is known about the effect on long-term defoliator dynamics of increasing a given bird population through management. It has been observed that the best forest sites often produce the highest populations of Modoc budworm and also the trees most tolerant to defoliation. Similar results have recently been observed in fertilized stands where both the western budworm and its host trees have benefitted from the addition of N. Fertilization has initially made these stands more "susceptible" but also less "vulnerable."

Species of defoliators exhibit different patterns of numerical behavior in their population trends. Cyclical behavior such as that in populations of the Douglas-fir tussock moth is produced by delayed negative feedback from the upper and/or lower trophic levels. The prolonged budworm outbreaks in the West suggest that this system lacks a strong negative feedback so that high populations persist in the most susceptible stands until trees are severely damaged or killed. A prevailing theory on the origin of budworm outbreaks proposes that populations initially build up in these susceptible stands and then spread into less favorable ones. A long-term management approach should be aimed at identifying and changing the forest conditions of such epicenters.

WORKSHOP: INSECTS OF SEEDS & CONES AND THEIR MANAGEMENT

Moderator: R. W. Thier

Participants: Twelve folks made lively conversation

Introductions were made and the workshop opened to a free exchange of ideas.

The group first discussed timing the application of acephate implants. Implants made too late do little to protect Douglas-fir cone crops from western spruce budworm damage. Now Jack Stein, Roger Sandquist and others are interested in applying implants the fall prior to cone development. If effective, fall implants would reduce travel problems and associated costs. Dave Overhulser stated that fall implants may treat nonexistent cone crops and cones should be present before being treated. Mike Jenkins responded that he found unidentified lepidoptera, perhaps western spruce budworm, overwintering in reproductive Douglas-fir buds and argued that Douglas-fir is producing buds but those infested probably abort before cone crop evaluations.

Mike Jenkins described his cooperative study to survey the cone and seed insects of larch. Peter Amirault stated he conducted a similar study in eastern larch and found both budworm and internal cone feeding insects caused significant losses. Various participants stated that research was needed since larch seedling demand was high.

Tim Schowalter described his studies. They showed that various cone and seed insects display a family feeding preference. Tim stated this feeding preference is a heritable trait manifesting itself in the trees' progeny. Scott Cameron agreed that there are clonal differences for insect feeding in the south regardless of where the trees are planted.

The discussions next moved to insecticide use in seed orchards. Scott Cameron stated that southern seed orchards are returning to multiple applications of azinphosmethyl after having secondary problems with carbofuran and fenvalerate. Now trials are being conducted using chlorpyriphos, Bacillus thuringiensis and others. Dave Overhulser stated that fenvalerate did not cause problems in the west but following applications of acephate secondary insects multiplied.

Finally all agreed cone and seed insect monitoring systems were needed. Presently, spraying begins when pest signs are noted. If monitoring results and pest impacts could be correlated, control strategies would become more efficient.

WORKSHOP: INSECTS OF REGENERATION AND THEIR MANAGEMENT

Moderator: Bill Bedard

Participants: 25 attended

Discussions were open and informal with the active participation of people from western Canada, western, southern, and southeastern USA. They are summarized according to reoccurring themes.

The injury of some of the species traditionally viewed as pest of plantations may be symptomatic of poor growing conditions or poor silivcultural practices. Examples are pine reproduction weevil, Yosemite weevil (reported previously), and gouty pitch midge (new conclusion).

"Stressed" hosts may provide better substrates for pest development than "unstressed" hosts. In Arizona, Survival of sawfly eggs is higher in hosts with high plant moisture stress than in hosts with normal moisture relations. Means to quantify pest-caused injury to individual trees in terms of stand growth and development are not generally available and are complicated by: 1) inability to predict growth in the absence of injury; and 2) unclear definition of product(s).

Management practices have profound effects on the site and the pest complexes affecting the crop. In Europe, the combination of acid deposition of air pollutants with acid mulch from planted conifers acidifies the soil to the degree that some nutrients are made unavailable for plant growth. In, Australia, each rotation of planted pines reduces the productivity of the site one site class. In the South, different regimens of vegetation control and fertilizer in loblolly pine plantations result in different combinations of tipmoths, pitch canker, and fusiform rust. In California, site preparation methods that resulted in soil removal have exacerbated gouty pitch midge-caused injury as has inadequate vegetation control.

The trend toward planting fewer trees per acre increases pest problems because less mortality and injury can be tolerated.

A common theme was the need to know more about the biology of young stands particularly the interactions among soil, trees, and pests and any other major actors affecting these interactions before we can accurately predict pest impact.

WORKSHOP: BARK BEETLES

Moderator: Gene Lessard

Participants: 46

Discussion center around strategies for managing bark beetles and the time "bought" before recurrence of bark beetle in a stand following application of a particular strategy. There was general agreement that suppression of bark beetles is difficult, if not impossible, to accomplish and buys only about 1 to 2 years of time. However, most agreed that suppression is a viable strategy when integrated into a silvicultural approach to stand management. Precommercial and commercial thinnings appear to be the preferred strategy short of regeneration harvesting. Optimally, thinnings appear to be relatively free of beetle-caused tree mortality for about 20 years - or until crown closure occurs within the treated stand. Substantial deviation from the optimum occurs if disturbance occurs within the stand. Disturbance can take the form of mechanical disturbance, such as blowdown, or biological disturbance, such as the presence of root pathogens in the stand.

Most agreed that thinning needs to be statistically tested through a replicated design for major host/bark beetle complexes. At a minimum, tree physiologists, plant pathologist, population biologists and pest management specialists should be involved in the design and conduct of these tests.

WORKSHOP: RECENT TESTS OF DEFOLIATOR SEMIOCHEMICALS
Moderators: Gary Daterman and Chuck Schwalbe
Participants: Herb Kulman, John Wenz, John Neisess, Dennis Hart, Don Dahlsten, Sandy Gast, Bernie Raimo, Wayne Bousfield, Andy Egletis, Bill White, Chris Niwa, Julie Weatherby, Steve Burke, Karen Clancy, Larry Stipe, Jed Dewey, Tom Hofacker

Jed Dewey, John Wenz, Chris Niwa, and Chuck Schwalbe led discussions on western pine shoot borer, Douglas-fir tussock moth, ponderosa pine tip moth, and gypsy moth. Emphasis was on use of pheromones for suppression; however, considerable discussion also concerned detection and monitoring. This was particularly the case for gypsy moth. Schwalbe explained in considerable detail the philosophies and procedures followed by APHIS and cooperating agencies for use of pheromone-baited traps to focus on new infestations of gypsy moth. Ponderosa pine tip moth appears vulnerable to the mating disruption approach to control for much the same reason as western pine shoot borer, namely because low-density, relatively stable populations cause damage in young plantations, and the disruption approach is most effective against low-density pests. Wenz reported on a 1986 field trial of mating disruption on Douglas-fir tussock moth in California implemented in cooperation with Lonne Sower of the USDA Forest Service's PNW Research Station. The test was directed against a population density of tussock moth just approaching the outbreak stage. It was pointed out that EPA registration for operational use is the next logical step in development of this tool for the tussock moth.

Dewey reported on the operational use of the mating-disruption technique to control western pine shoot borer in progeny test sites of ponderosa pine in Idaho and Montana. Suppression of damage has been successful except in those plantings that are surrounded by infested natural stands from which mated females can readily fly into the treated area to lay their eggs. Because of this problem, one progeny test location was dropped from further treatment. Cost of treatments was discussed in some detail.

WORKSHOP: Models to predict Insect Outbreaks and Losses
MODERATOR: Jesse A. Logan
PARTICIPANTS: 16 registered participants

Most of the discussion in this workshop involved some aspect of insect outbreak models. A fair amount of time was spent discussing the relative strengths and weaknesses of various types of models. The focus of much this was empirical vs. mechanistic models. At least for the types of applications most of the workshop participants were interested in, there appears to be a need for mechanistic representation of ecological processes. Empirical models were viewed as too inflexible to be of much value.

A considerable amount of time was also spent comparing highly complex (large scale simulation) models as apposed to simple theoretical types of models. In general, there was a lack of consensus about the relative value of each approach, although strengths and weaknesses of both approaches were pointed out. This is perhaps a reflection of the difficulty of evaluating any model without a clear and specific statement of objectives for the model.

There was an interesting discussion about the use of models in prediction. The point was made that political/economic parameters are so volatile that long term planning is futile. In view of this uncertainty, someone observed that, "the role of prediction is not predictable."

There was some discussion about the current application of models in the decision process. Once again there was a lack of consensus. Apparently models are extensively used in some regions, and hardly at all in others.

Overall, this workshop is extremely difficult to summarize. A central focus was lacking, and the discussion seemed to flit from one topic to the next without reaching many solid conclusions or recommendations. However, one recommendation came through loud and clear: Include bugs in FPM, at least recognize that insects have an impact!

WORKSHOP: ENDEMIC POPULATION STUDIES
Moderator: Les Safranyik
Participant: Twenty-five persons attended

Discussion commenced with the moderator reminding the participants of the importance of clearly defining the concepts of endemic and epidemic as population states rather than relative damage levels caused by an insect population. Two questions were raised: a) Why study endemic populations of forest insects? b) What problems are attendant with the design, conduct and analysis of endemic population studies? The answers to question a) included the need to know the main factors responsible for the maintenance of the endemic state, cause(s) of population "release", and the modes of action and effects of the various factors that counterbalance the large reproductive potential of insects. In answering question b), it was pointed out that even today institutional support for population studies are more readily available during periods of epidemics. In endemic state, some insect populations are so low that either we do not have adequate techniques for measuring their size with acceptable degree of precision and/or lack the resources to do so.

The following problems relating to active studies of endemic bark beetle populations and needs for new work were identified:

a) Measurement and elucidation of the role of dispersal (Dick Schmitz, John Schmid, Les Safranyik).

b) Relationship between stand disturbance (lightning, wind, etc.) and bark beetle activity (Bob Coulson, John Foltz, John Schmid).

c) Factors of host predisposition to attack (disease, drought) and their role in bark beetle population dynamics (Dick Schmitz, John Foltz).

d) Brood productivity in endemic populations vs. stand and site factors (C.J. DeMars).

e) Technique for identifying endemic populations of the southern pine beetle based on the relation between population size and replacement rate (in terms of trees killed in subsequent years (Fred Hain).

WORKSHOP: BIOLOGICAL CONTROL

MODERATOR: Don Dahlsten

PARTICIPANTS: 19

Biological control is a very broad topic so the discussion group chose to focus on bark beetles, and the conversation ranged from some rather novel approaches to an evaluation of natural enemies. There was a good discussion of the degree of association of a natural enemy with its host and the potential for biological control. John Moser discussed his work with the phoretic mites of the southern pine beetle and an analysis of the degree of association of these mites with the southern pine beetle that was done by D. S. Wilson in his recent book on natural selection. Wilson's conclusion, which is based on the theory of structural demes, is that the mite species with a low index of association with the southern pine are the important predators, and those that are the closest associates with the beetle will evolve positive relationships with the beetle, i.e., they will not prey on the beetles. This essentially supports the "new association" theory of Pimentel. The discussion then turned to ways that the predaceous mites with a low association index might be manipulated to increase their biological control potential. Moser suggested that it might be possible to transfer the gene for phoresy to the more effective predaceous mites.

Stu Whitney discussed the possibilities of using various microbes for the biological control of bark betles with particular reference to his work with the mountain pine beetle in lodgepole pine in western Canada. It was the general conclusion of the group that while very little is known about the parasitoids and predators of bark beetles, even less is known about the microorganisms associated with bark beetles. A number of possibilities were discussed and this included fungi (yeasts), bacteria, protozoans, and viruses. There may be some possibilities with the fungus Beauveria, but retention could be a problem. A new strain of Bacillus thuringiensis that is effective against Coleoptera was mentioned, but this could be a problem with cryptic insects such as bark beetles, as it may not be possible to get enough of the organism to the beetles. This may be true with other pathogens, too.

Whitney stressed that a detailed survey should be made of the microorganisms associated with bark beetles, especially in those cases where there are brood failures. It may be possible to create hostile habitats with slime flux (sour sap), mycoparasites (e.g. Trichoderma) or antibiotics. It has been observed that actinomycetes are common when a brood fails. The use of aureomysin was also mentioned. So little work has been done and so little is known that there is a real need for research in these areas. The group felt there was a definite potential for some success. The use of biotech approaches was also mentioned, such as altering the blue stain fungi to make it pathogenic to the bark beetles, removing Vitamin B production from yeasts, and designing yeasts to produce excessive amounts of verbenone.

Bob Bridges reviewed some of his work with the symbiotic (mutualistic) fungi associated with the southern pine beetle. There are many organisms, but only a few are known. Bridges noted from his observations that there were large variations in two fungi that dominate with the southern pine beetle from tree to tree and spot to spot. There is a need to understand the role of these microorganisms in the population dynamics of the bark beetles. It may be possible to manipulate the fungus that dominate and thereby exert control of the beetle populations. It was mentioned that some fungi

Fred Stephen concluded the session with a review of his work on demonstrating the importance of natural enemies (parasitoids and predators) in southern pine beetle population dynamics. He was able to share a numerical response of natural enemies to bark beetles. Marc Linit was able to demonstrate a functional response with the southern pine beetle.

In general, the potential for biological control of bark beetles has barely been evaluated. A number of interesting approaches were discussed in this session, and it appears that there are a number of different avenues that should be pursued. As with all research, the bottom line is money. Biological control research and the evaluation of natural enemies of bark beetles has been poorly funded to date. It was evident from this session that the researchers and the ideas are there, but the money isn't!

sd4

Workshop: ANTI-HERBIVORY COMPOUNDS AND THEIR ROLE IN INSECT-HOST INTERACTIONS
Moderator: Rex G. Cates
Participants: 34 attendees

Based on introductory remarks given by each attendee, it was clear that a great diversity of interests in the area of plant - insect interactions existed among the individuals in the workshop. As an example of this diversity, interests included the role of varying resource availabilities on plant growth, tissue phenology, and secondary metabolite patterns, the role of among-tree variation in terpenoid precursors to insect pheromones in tree susceptibility, resistance, and suitability, the importance of the induced reaction in phloem and sapwood to resistance, susceptibility, and suitability characteristics of host trees, the relationship between the oleoresin preformed system to the induced reaction in the degree of host tree resistance and suitability, and the relationship between tissue quality and natural enemies on plant-feeding insect - associated fungi population dynamics.

Specific comments or presentations were made in the area of plant - insect interactions primarily dealing with the southern pine beetle, its associated fungi, and their host trees. For example, Dr. Tim Paine presented some of the preliminary work of David Goldhammer, who is a graduate student working with Dr. Fred Stephen, University of Arkansas, on the effects of southern pine beetle frass on growth of fungi associated with SPB. Dr. Rex Cates and colleagues discussed the induced reaction of loblolly pine following inoculation with fungi associated with the SPB, and the variation in secondary metabolite quantities that exists in this reaction among individuals within a population. Dr. Pete Lorio outlined some of the considerations that exist among varying levels of resource availability, stress, tree vigor and bark beetle dynamics.

Several themes emerged from the workshop some of which follow. Due to the complexity that now exists in our knowledge of insect - host plant interactions, it was thought that interdisciplinary studies were greatly needed. A review of the interests mentioned above indicates the need to study in an integrated format the interrelationships among varying resource availabilities, tree physiology, host plant resistance and suitability, and bark beetle - fungal dynamics. Alternatively, specific studies in the same areas, among others, were recommended because interdisciplinary studies of a shallow nature may not elucidate satisfactorily the necessary detail needed to provide data for sound management decisions. In part due to the observed variation in natural systems in chemical and physical characteristics within a population, considerable interest was expressed for more research on the relationships among varying resource availability and plant resistance, tree suitability, seasonal and among-year growth patterns, and plant 'vigor'. Another important arena of research that was mentioned dealt with comparative studies among bark beetles, their associated fungi, and several host plant taxa, such as ponderosa pine, lodgepole pine, southern pines, and the California pines.

WORKSHOP: Anti-Herbivory Compounds and Thier Role in Insect-Host Interactions

MODERATOR: Rex Cates

THIRTY-EIGHTH WESTERN FOREST INSECT WORK CONFERENCE

Minutes of the Final Business Meeting
Park City, Utah, March 5, 1987

Chairperson Schmitz called the meeting to order at 1:00 p.m.

The minutes of the Initial Business Meeting and the Treasurer's Report as of March 5, 1987 were read and approved.

Chairperson Schmitz added to the list of awards Les Safranyik, Fellow Canadian Entomological Society Award.

The candidates selected by the Nominating Committee were: Ladd Livingston, Secretary/Treasurer and Christine Niwa, Councilor.

The Resolutions Committee thank the staff of Prospector Square Hotel for their hospitality, Gene Amman, Mike Jenkins and the program committee for an interesting and stimulating program, Dave Holland and the efficient local arrangements committee for the smooth running of the meeting and the social activities.

The 1989 venue will be somewhere in California at four possible areas: Lake Tahoe, Carmel, Berkeley, Southern California, - Don Dahlsten and Dave Wood to make arrangements.

Dave Wood commented on the suggestion to hold a Joint Meeting with Pathology with time of meeting being the biggest obstacle. It was decided to leave the California group to work it out with Pathology and get back to the membership.

Dave Wood summarized an article on "The Status of Support for Forest Pathology Research" to be published in Plant Disease, 1987. The decline in support to pathology is similar to what is happening in Entomology. We can make a common statement in Entomology and approach the National Academy for an evaluation. The Academy might take it on as a challenge to effect a change and to get funding for Ecological Entomological research.

It was decided that the FOREST INSECT WORK CONFERENCES should get together and plan a strategy. Dave Wood was to put something together with feedback by early fall for a report back to the membership on suggested course of action.

The motion, to determine if the membership was interested in proceeding among the other workshops on the decline in support for entomology with some report back to the membership in the fall, was carried by a majority vote.

Chairperson Schmitz thanked the Executive Committee and WFIWC members for their participation at the workshop.

The meeting was adjourned at 2:00 p.m.

TREASURER'S REPORT

Thirty-eighth Western Forest Insect Work Conference
Park City, Utah, March 5, 1987

Balance on hand March 2, 1987	(+)($4.493.83 CAN)	$3,300.00	US
Expenses:			
Catering - Mixer	(-)	604-25	
Coffee Breaks	(-)	572.01	
Conference Room Charges	(-)	50.00	
Audiovisual Equipment	(-)	85.00	
Registration Cost (Tags, etc.)	(-)	120.08	
Commemorative cups	(-)	628.66	
		2,096.00	US
Income:			
Registration (113 members + 10 students) Sale of Commemorative cups Sale of Proceedings	(+)	3,049.00	US
Balance on hand March 5, 1987	(+)	4,256.00	US

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. Officiel 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 raports. The Secretary-Treasurer is charged with the responsibility of preparing the proceedings for the conference in which his term of office is terminated (amended Feb. 28, 1967, Las Vegas, Nevada).

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

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

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

It is the responsibility of a Counsellor, should he be unable to attend an executive meeting, to appoint an alternate 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 data 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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USDA-FS U. S. Department of Agricultural-Forest Service
F&RES Forest & Range Experiment Station
F&RSL Forestry & Range Sciences Laboratory
NF/RD National Forest / Ranger District
S&PF State and Private Forestry

CFS Canadian Forestry Service
FES Forest Experiment Station
FSL Forestry Sciences Laboratory
MAG Methods Application Group
FPM Forest Pest Management

R-1 Northern Region
R-2 Rocky Mountain Region
R-3 Southwestern Region
R-4 Intermountain Region
R-5 Pacific Southwest Region
R-6 Pacific Northwest Region
R-8 Southern Region
R-10 Alaska Region

* Members registered at Park City, Utah.

REPORT OF HISTORY COMMITTEE

Historians are notorious for their cavalier perspective of current time, hence for a slow rate of progress by standards of other disciplines (except perhaps anthropology, archeology and pedagogy). Thus I could use this characteristic to explain the lack of personal input to this report. That, however, would be unfair to historians. The truth is that your secretary, having moved to Sandpoint in 1986, was embroiled in refurbishing a 1920's domicile to his spouses' specs. This, plus a health problem (unrelated, I think), resulted in my neglect of historical matters this past year. Thanks to others, however, we are making progress.

Doc Hall reported on material in his possession and/or submitted to the Forest History Society. If an elephant doesn't get him (he went on safari in March) we will urge him to transfer his material to the University of Idaho archives ASAP. The big item is a copy of the ORAL HISTORY OF FOREST ENTOMOLOGY IN THE WEST. The original is in the PSW files in Berkeley, Doc has sent a copy to the Forest History Society and will make a copy for our archives. The title is somewhat misleading since only oral presentations by Hall and Keen are included. Other material includes comments on the oral transcripts by Craighead and Beal, establishment of the research lab in Berkeley (Eaton), 31 years of forest insect research in California (Struble), Notes on the history of the WFIWC (Washburn) 20 years of the California Pest Action Council (Arvola), reminiscences (Bongberg, Evenden, Trostle, Terrell,, Phil Johnson, Orr, Don Parker), forest entomology at UC Berkeley (Stark) and Idaho (?), the Weyerhauser Research Center (Norm Johnson), and miscellaneous correspondence from various luminaries of the bug and tree scene.

Charlie Sartwell reported to Mal Furniss on the PNW photo file. It is now at LaGrande, Oregon, with Boyd Wickmans pest management research group. The collection consists of about 3,300 B&W photos, almost 3,000 for the period 1930 to 1906. Charlie speculates that pre-1930 pictures are primarily located in Berkeley. We will follow Mals' urging and impress upon our field workers the urgency of locating and preserving similar treasures at all western labs and universities.

In addition to working with Charlie S., Mal Furniss reports that he has an 83 page unedited transcript of R.C.Larsons' 1977 interview of Bob Furniss. Mal is contemplating writing a biography of his brother but warns us all that he has no time goal set - like most'retirees' he is incredibly busy.

John McLean got in this years' report just under the wire. He sent the Archives, through me, a copy of Hec Richmonds' "Forest Entomology; from Packhorse to Helicopter" (1986), and a copy of a photograph of the UBC student and staff delegation.

My principal tasks in 1987-88 will be to stimulate all our field historians to get cracking and locate material for submission to the Archives, compile a list of planned historical projects, and submit my personal papers to the Archives. Remember, we are all involved in creating history, play a part in preserving it! Don't throw it out - send it to

Dr. Terry Abraham, Head Special Collections, Library, University of Idaho, Moscow, Idaho, 83843. (Let me know).

Respectfully submitted,
Ron Stark
April 6, 1987