PROCEEDINGS

of the Seventeenth Annual

WESTERN FOREST INSECT WORK CONFERENCE

Victoria, British Columbia

February 14-17, 1966

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Prepared at

Division of Timber Management
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Region Four
Ogden, Utah

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Prepared by the Secretary-Treasurer, G. C. Trostle, from summaries submitted by Workshop Leaders. Stenographic services and duplication processing provided by the Insect and Disease Control Branch of the Division of Timber Management, U. S. Forest Service, Region 4.

CONTENTS

SEVENTEENTH ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

February 14-17, 1966

The meeting convened in the Empress Hotel, Victoria, B.C., at 9:00 a.m. and was opened by Chairman, J. M. Kinghorn.

Mr. R. R. Lejeune, Regional Director, Forest Research Laboratory, Victoria, and Mr. F. S. McKinnon, Deputy Minister of Forests for British Columbia welcomed the group.

MINUTES OF THE INITIAL BUSINESS MEETING

J. M. Kinghorn named the following conference members who have recently retired and they were duly recognized by the group:

Bill Wilford, Don Parker, John Whiteside, Homer Hartman and Roy Nagel.

Kinghorn appointed a Nominating Committee consisting of Bill Wilford (Chairman) Norman Johnson and Rob Reid. Vacancies to be filled are Chairman, Secretary-Treasurer and one Councilor.

The treasurer's report was approved as read. The balance on hand as of February 9, 1966 was $414.17.

The Minutes of the final business meeting at Denver were read, and were accepted on a motion by Schenk and Landgraf.

After considerable discussion regarding meeting places, R. E. Stevens, moved that the 1967 meeting be held in Las Vegas, and that we invite Mexican entomologists, and also pathologists to participate in the conference. Seconded by D. Dotta. Carried.

R. W. Stark moved that the 1968 meeting be held in Alaska. Seconded by R. Hall. Motion defeated.

The group generally did not favor meeting in Mexico, but there was more support for meeting in a location near the Mexican border. There was also some support for meeting in California.

Kinghorn suggested it would be well not to attempt to come to a final decision on the 1968 meeting at this time but after some thought and discussion during the next few days, decide on the location and if possible, a theme at the final business meeting.

The meeting adjourned on a motion by A. E. Landgraf, Jr. at 10:20 a.m.

THE DIMENSIONS OF WEATHER

(Resume of talk to W.F.I.W.C.)
By J. A. Turner

Meteorologist, Forest Protection Division
Canadian Department of Transportation

The central theme of "Dimensions of Weather" was developed briefly in four general areas:

1. to stress the importance of thinking of weather in terms of all three space dimensions as well as in the dimension of time;

2. to indicate briefly how complex problems in the four-dimensional universe could sometimes be simplified, either from the point of view of mathematical modelling or of setting up an observational network, to a problem in one or two dimentions;

3. to suggest how the generalized concept of "dimensions" is applied to atmospheric modelling experiments;

4. by looking in particular at the dimension of time in connection with speed of response of instrumentation and time averaging of observations.

THE FUTURE OF BIOCLIMATOLOGY IN INSECT RESEARCH

By R. W. Stark

It was pointed out that, with a few notable exceptions our approach to bioclimatology has been somewhat restrictive. Atmospheric circulation, the hydrologic cycle, biological ecosystems and human production are interlocked. We must adopt an holistic view of the ecosystem. One portion of the environment grossly neglected has been the climate <u>below</u> the ground.

The possibility of preparing distribution maps for insects based on climate was reviewed, not only with respect to spatial distribution but also potential abundance.

Not enough effort has been expended as yet in developing integrated studies involving many disciplines. Advances in the field of electronics now permit measurement of a diversity of climatic components in previously inaccessible areas and high speed computers permit the assembling and analysis of vast amounts of data. Recent developments in programming allow the assembling of elaborate data maps which give comprehensive views of problems. These in turn, permit the construction of invaluable complex theories and models which can be tested for validity and productivity with only partial data.

It is my belief that bioclimatologists and other scientists employed in forest entomological agencies are guilty of forgetting one of their prime responsibilities - forest protection. A more desirable balance of research is required to investigate the possibilities of weather and microclimate modification as a means of reducing insect numbers. Such studies would include practical predictive devices such as insect-climate distribution maps, soil moisture predictions and the use of cloud "patterns" to classify local climates.

The "electronic explosion" was described with reference to the new equipment and techniques available for bioclimatological research. Radio transmission of temperature and light data from inaccessible locations was demonstrated by R. Dalleske and H. Kimmins of the University of California. It is our opinion that the only limiting factor (other than money) is our imagination. Other "new" advances mentioned include temperature "memory" cells, incredibly small radio transmitters and radar.

The difficulties of communication were reiterated and mention was made of the services of the Biological Instrumentation Advisory Council (BIAC) sponsored by the American Institute of Biological Sciences. Criticism was levelled at our group for a general failure to accelerate communication with the exploding technological fields and in particular in transmitting our findings to the forestry profession through appropriate journals.

BIOTELEMETRY: A TECHNIQUE FOR ENVIRONMENTAL DATA ACQUISITION

By J. P. Kimmins
Graduate Student, University of California, Berkeley

Trends in modern research are placing increasing demands on techniques of data collection and instances are constantly occurring when conventional methods may prove inadequate. When this occurs, the logical course of action is to seek improvement.

Environmental measurement has for long depended upon conventional meteorological equipment but there is fairly general recognition of the fact that available instrumentation for micro-climatology is often inadequate. This very problem led the authors to turn from the use of thermocouples in conjunction with a field potentiometer, to a telemetry system, in this instance, for the measurement of sub-cortical tree temperatures.

Telemetry is the measurement and transmission of data via radio-waves from one location to an observer or recording unit some distance away. The success of biotelemetry is based on cooperation between the biologist and the electronic engineer; without this team approach, the technique is less likely to yield its full potential.

Biotelemetry is a very new technique, dating from about 1957. It is a very flexible technique, being of moderate price, compact and adaptable.

The use of biotelemetric systems has received most attention from zoologists in the field of animal tracking, which accounts for over 50 percent of the research application of the technique to date. It has not been used much in the field of environmental and micro-climatic measurements despite its considerable potential in this respect. It appears to be well suited for problems where conventional instrumentation will not perform adequately, but more important, it will enable one to make many measurements previously considered impractical.

DEMONSTRATION OF A RECENTLY DEVELOPED TEMPERATURE TELEMETER

By Robert L. Dalleske
Graduate Student, University of California

The complete apparatus consists of four elements: the telemeter, an inexpensive transistor radio, a meter box, and a decoder unit. All parts of the system are completely transistorized. Although this particular telemeter was designed primarily for the measurement of temperature, other resistance transducers can be used to measure, for instance, light intensity and humidity. The telemeter is entirely weatherproof, and may be left unattended for long periods of time. The transmitting range of the telemeter is about 175 years, and this may be increased by slight modification. The cost of one complete unit is about $65. Mr. Kimmins and myself are presently working on a system that will enable us to use several telemeters at the same time and also feed the data output from the decoder into a pen recorder, Circuit details, and construction techniques will be available to interested parties in the near future.

CLIMATIC INFLUENCES ON BARK BEETLES

Philip C. Johnson, Discussion Leader

In introducing this topic one is immediately confronted by a realization of dramatic advances in recent years in the science of bioclimatology. Forest entomologists are avidly soaking up each new bit of knowledge from this relatively new discipline to explain old hypotheses and to substantiate new ones. If the name of this fast-growing science elicits the promise of new horizons, the well-worn terms "weather" and "climate" seem to demand a new respect from many of our colleagues venturing forth into intriguing investigations on climate-biologic relationships.

For years students of bark beetles have accepted almost without question certain influences attributed to climate. Reasonably stable patterns of seasonal weather over long periods of time are basic to defined ecologic zones. Thus, distribution of bark beetle species, as well as their host plants, is given definite limit. Behavior of insect populations within each zone takes on remarkable constancy which determines the number of generations per year and the adaptability of metamorphic stages to seasonal weather conditions and to the phenology of host plants.

These same students have witnessed the impact on bark beetle broods of short-term deviations in weather--the abnormalities of brood development, behavior, or of life itself from the catastrophic excesses on the more subtle departures from seasonal occurrences of the elements of weather. Much of our pioneer investigation of bark beetles was not so much concerned with long-acting influences of climate as it was with vividly expressed reactions of beetle populations to violent fluctuations of weather in one or more seasons of a particular year.

We remember well examples of this, taking for granted that which seemed obvious and shrugging off or hypothesizing without too much confidence that which was unexplainable. We accepted an 85 percent mortality of overwintering broods of *Dendroctonus brevicomis* as attributable to minus F degree temperatures in a part of California where subzero temperatures seldom occur. We were perplexed when the 15 percent residual population built back up to exceed pre-freeze population levels in the succeeding generation. We were sure that drought conditions during the 1930's triggered the largest most damaging outbreaks ever recorded for this same insect. But we were not sure of the "why."

Gradually, we began the inevitable organized approach to learning about relationships between climate and weather and fragments of bark beetle biology. Forward-looking colleagues some years ago started us in this direction. They took good measure of the lipid content changes in beetle populations brought on by changes in seasonal climate. Some translated this into cold hardiness and the ability of various beetle life stages to withstand minimal temperatures. Others began looking at seasonal and year-to-year changes in soil moisture as it affected the vigor of host trees.

The conference as a whole is programmed around the strides made in the basic knowledge and technology of bioclimatology. We intend to present evidence by our panel members of the increasing involvement of bioclimatic principles in current bark beetle research and to provoke discussion pointing to even greater effort toward a fuller understanding of the role of this environmental science as it affects the biology, ecology, behavior, and control of important bark beetle pests.

PANEL: CLIMATIC INFLUENCES ON BARK BEETLES

By L. H. McMullen

Winter Mortality:

Mortality of overwintering bark beetles has often been attributed to cold weather conditions. The degree of mortality may be influenced by the intensity, duration and the timing of cold periods. Other factors such as the species of beetle, the stage of the life cycle entering the winter, and the hardiness of a population due to the normal cold temperatures to which it is subjected may also influence the mortality. Environmental conditions such as bark characteristics, exposure, location of infested material in relation to regional cold, and snow cover are also important factors.

Data collected over a period of ten years in the interior of British Columbia provide examples of characteristics of cold weather which were associated with winter mortality of the young adults of the Douglas-fir beetle. The most severe mortality (about 70 percent) occurred during a year in which there was a sudden severe drop in temperature in early November as well as a prolonged intense cold period in late December. Less severe mortalities (30 to 40 percent) were associated with years in which the temperature dropped suddenly in November or prolonged periods of cold weather occurred during the winter.

In addition a similar level of mortality occurred in one year in which severe temperatures were not prevalent. The development of the brood had been delayed by cool weather the previous summer and also the number of progeny per unit area was low. These features indicate a possible relationship of mortality to condition and stage of the overwintering brood.

INFLUENCE OF TEMPERATURE AND MOISTURE ON BARK BEETLE BROODS

By R. W. Reid

Summary

Temperature and moisture regimes within the subcortical region of infested trees affects the length of the egg gallery and number of eggs laid; the number of egg galleries established by the parent adult; the length of incubation period and the hatching success of the eggs; the rate of brood development; the amount of brood mortality; and the time of brood emergence. Examples were given to illustrate these relations. More work is required. Assessment of the role of temperature and moisture is hindered by inadequate techniques of measurement, particularly in regard to moisture.

THE EFFECT OF WEATHER FACTORS ON FLIGHT AND

DISPERSAL OF SOME SCOLYTID BEETLES IN WESTERN NORTH AMERICA 1/

By Malcolm M. Furniss

The effect of weather on the flight of bark beetles is not well studied. Field observations have accrued mainly in conjunction with studies of host selection and attraction. Exhaustive, controlled laboratory studies have been few indeed. Most of what is known has been obtained by contemporary entomologists along the Pacific coast, in the past 10 years.

Flight is vital in the search for suitable breeding material. Its success greatly influences the amount of damage caused either by the flying generation itself or by their progeny, the numbers of which in turn depend in part on the quality of host material infested by their parents. Any factor that affects flight activity needs to be thoroughly understood. This is not the case with most scolytids at present.

Of the commonly recognized weather factors, temperature has been used faithfully by nearly every investigator. Humidity, light, and perhaps wind (especially near the ground) rank next in usage in flight studies. Atmospheric pressure has received scant attention and the direct effect of precipitation on flying bark beetles has been reported seldomly, although it can be inferred readily. Studies involving simultaneous combinations of as few as 2 weather factors, each of varying intensity, are rare, also. Least studied of all is the influence of the electrical state of the atmosphere although recent work by Maw (1961, 1965) has shown that some insects avoid landing on charged surfaces and an air stream containing positive ions may lengthen and speed the flight of an insect.

Accidental dispersal of scolytids, as by winds above the forest canopy, has not been shown to be an important factor, compared to directed flight within the forest. Taylor (1958) advanced the concept of a boundary layer, defining it as the lower layer of air where an insect can control its track. The depth of the layer depends upon the flight speed and wind speed. He believes that most insect dispersal is adaptive and that accidental movement (i.e., escape from the lower boundary layer and loss of control over direction) is rare.

1/ Presented at 17th Western Forest Insect Work Conference, Victoria B. C., February 15, 1966.

If accidental dispersal is unimportant in bark beetles, this is probably due to (1) the cessation of scolytid flight at low wind velocity, (2) the compact anatomy of bark beetles, (3) the moderating influence of the forest on the wind within it, and (4) the beetles' tendency to remain within the forest perhaps in response to chemical stimuli. However, if a species requires great flight exercise to release it from photodominance or if hosts are not readily available, its chances of accidental dispersal should be increased.

The three most thoroughly studied American scolytids in relation to the effect of weather factors on their flight are: Dendroctonus pseudotsugae Hopk., Ips confusus (Lec.) and Trypodendron lineatum (Oliv.).

I. Dendroctonus pseudotsugae Hopk.

The effect of temperature on the flight of the Douglas-fir beetle was studied in the laboratory by Rudinsky and Vite (1956). In shade, flight did not occur below 20° C. At 22° C. beetles took to flight readily, while flight was spontaneous at 25° C. Between 25-32° C. flight was more flexible, allowing beetles to continue flying oftener when they collided with objects. In sunlight, flight occurred at lower temperatures (18-20° C.) than was possible in shade, and greatest flight performance occurred in sunlight at 20° C. They also noted that at take-off, light source alone directs the beetle, but beetles become negatively phototropic below 11° and above 34° C.

Further laboratory studies were conducted by Atkins (1959, 1960, 1961) involving flight preparation and response, flight movements, and flight capacity. His experiments with light indicate that flight does not occur at intensities as low as 1/2 foot-candle even when temperature remains favorable. Thirty-five foot-candles were sufficient illumination to cause all responding beetles to fly at 23-25° C.

Wing beat frequency increased to a maximum at approximately 32° C., 70-90% R.H., and 300-500 foot-candles. Wing beat frequency increased 1.6 cycles per second for each 5 pounds increase in vacuum over the range of pressure at sea level to 25 pounds vacuum. He states that changes in wing beat frequency were probably passed on to flight velocity. Both temperature and R.H. had little effect on total flight, exclusive of the number of stops, but increase in either factor increased the duration of initial flight.

In the field, beetles became active at temperatures above 65° F. with little or no precipitation. After emerging, beetles could maintain flight in air as cool as 60° F. In April, number of flying beetles was directly correlated with temperature, reaching a peak at noon and terminating well before sunset. However, in June and July, high temperature at noon brought about a depression in flight, with a smaller forenoon and greater late afternoon peak. Sunset terminated flight even though evening temperature was sometimes optimum for flight.

Dispersal flight was usually oriented with wind but concentration flight toward attractive material was always oriented against wind. At wind velocities up to 3 m.p.h. the beetle flew well and at a height of 5 feet above ground. Good flight and orientation were possible during frequent gusts of 4-9 m.p.h. when prevailing breeze was light, but beetles flew closer to the ground. Continuous wind of 5 m.p.h. terminated the concentration flight although emergence continued.

II. Ips confusus (Lec.)

Gara and Vite (1962) studied the seasonal and diurnal flight patterns of this species. These patterns were mainly influenced by sources of attractants and weather conditions. Temperature seemed to be the most limiting factor.

Peak random flight occurred around 1:00 p.m. in the spring and 4-6:00 p.m. during summer. However, selective sampling with olfactometers showed a morning peak (from beetles emerged previously) and an afternoon peak. Morning flight was initiated at 19° C. but the response to olfactometers was interrupted as soon as temperatures rose above 28° C. Take-off was predominantly with the wind, especially in wind higher than approximately 2 m.p.h. In calm air, beetles tended to fly upward for several meters, then flew horizontally. In higher winds, beetles took off downwind, then flew upwind to the source of attraction. Flight also occurred closer to the ground as wind velocity increased. Light conditions seemed to have little influence on response flight as opposed to dispersal flight, except that direct solar radiation seemed to be avoided.

III. Trypodendron lineatum (Oliv.)

Adults of this species over-winter in duff rather than in the brood tree. In Britism Columbia, Dyer and Kinghorn (1961) noted that peak numbers of overwintering adults occur approximately 200 feet into the forest from clearings where incident light readings are lowest. Spring flight, in search of green logs, occurs when daily maximum temperature exceeds 60° F.

Chapman (1962) observed that flights often occur when sun is obscured by clouds, if the air is warm enough. The typical flight orientation is against wind. Height of flight is 10-15' in the timber but lowers to 6-8' after beetles reach the open area. There is no tendency to fly upward into the sky. Above 3.4 m.p.h. the number of beetles in flight dropped markedly. At 4 m.p.h. they showed zero ground speed. When wind subsided a decline occurred in the numbers of beetles passing the observation point.

IV. Crepuscular species

In California, Gara and Vite (1962) observed that *Hylastes* flew during evening hours, with the peak at 6:00 p.m. during both spring and summer. Largest number of *Hylastes nigrinus* were in flight at light intensities below 500 foot-candles. Crepuscular flight pattern was not correlated with relative humidity.

In Oregon, Daterman et al. (1965) categorized *Hylastes*, *Gnathotrichus* and *Dryocoetes* as crepuscular.

SUMMARY

The following is a summary of the relationships involved between weather and bark beetle flight based largely on the foregoing discussion.

Temperature.--

1. Initial flight depends primarily on temperature.

2. Air temperatures of 9-20° C. are recorded as flight thresholds for various bark beetles (Rudinsky 1962).

3. Flight can occur at a lower air temperature in sunlight than in shade.

4. Once in flight, beetles may continue flying at temperatures below that needed to initiate flight.

5. At high temperatures, beetles become negatively phototropic. This reaction and possibly others may cause day fliers to have 2 peaks of flight activity on summer days--one in the morning and one in the late afternoon.

Wind.--

1. Exceptions occur, but in gentle wind, take off and dispersal tends to be down wind. Without wind, take-off is not directional.

2. Concentration toward attractive host material is invariably upwind.

3. As wind increases, beetles fly closer to the ground.

4. Flight is arrested by prevailing winds of 3-1/2 - 5 m.p.h.

Light.--

1. Scolytids do not fly in the absence of light.

2. Day-flying species terminate their flight in late afternoon when light intensity decreases even though air temperature remains permissive.

3. Other species are crepuscular in their flight habit.

Humidity and Air Pressure.--

Except for periods of actual precipitation, these factors have not been reported to limit flight of bark beetles in the field. The brief period of favorable weather needed to locate a new host tree may explain why these factors have not been found to be of greater importance.

"CLIMATIC INFLUENCES ON BARK BEETLES"

Oleoresin Exudation Pressure in Ponderosa Pine and its Influence on Susceptibility to Infestation by *Dendroctonus brevicomis*

D. L. Wood and R. W. Stark

A study was initiated in 1961 to clarify further the relationship between low oleoresin exudation pressure (o.e.p.) in ponderosa pine and susceptibility to infestation by *Dendroctonus brevicomis* Lec. The highest pressure reached during the diurnal run of transpiration was recorded for about 700 trees and the lowest pressure was obtained for all trees exhibiting an o.e.p. greater than 80 p.s.i. Variation in o.e.p. according to season showed the highest level occurring in July and declining slowly through September until all trees reached zero in December. Pressure probably begins to ascend sometime in April but is still very low in May. This loss of pressure probably reflects the rigorous winter climate in the Sierra Nevada Mountains at 5,000 feet and is undoubtedly related in some way to dormancy. A much more sensitive indication of seasonal variation occurred in the low pressure values obtained, with the magnitude of the pressure loss increasing as the season progresses reaching the highest point in September. There does not appear to be any significant variation in either the high or low o.e.p. between any of the years in which this study was performed, despite the fact that two years were far below normal rainfall levels and heavy bark beetle losses were sustained in the plots, while in 1965 rainfall was above normal. Although no correlation was found between the high o.e.p. and subsequent mortality caused by *D. brevicomis*, the relationship between the low o.e.p. reached in the diurnal run and susceptibility remains to be established.

THE EFFECT OF PHYSICAL FACTORS ON THE EMERGENCE OF SCOLYTIDS

By W. D. Bedard

Emergence dates vary from year to year for a given species. These variations are influenced by weather and are important to both control operations and the success of local beetle populations.

Physical factors regulate development leading to emergence. Three steps in this developmental pathway either directly or indirectly known to be weather regulated are:

a. The development of larvae, pupae, and new adults.

b. The change in adults from feeding-reproducing activity to emerging activity.

c. The final act of emergency.

There is a good deal of variation among species as to how physical factors regulate emergence. Different developmental steps are influenced by different mechanisms. Even the sexes of a single species differ some in their emergence characteristics.

The emergence of scolytids seems to have one thing in common. This is the frequent occurrence of a physical factor-regulated mechanism to synchronize emergence at times favorable for flight.

Possibly the future will bring a more careful analysis of what components of the physical environment affect what developmental and maturation processes in order to influence emergence. Such studies might bear fruit in application of new control methods such as sex attractants. They might find ways to chemically induce emergence during periods of poor flight and attack weather.

WORKSHOP: TREE PHYSIOLOGY AND INSECTS

Moderator - D. C. Schmiege

Discussion in this workshop did not follow a prepared plan. About half of the 28 members present participated.

The major portion of the discussion centered around what should be done and what is planned in the field of tree and insect physiology. The question "What is the relationship between insects and trees" could not be answered very adequately. The reason for this is that some work has been done on tree physiology and some on insect physiology but the two are not studied as a unit. It was brought out that the biochemistry of forest insect pests is not well known.

Tree resistance to insect attack was discussed. This has been observed in the field but the factors responsible are not well known. Some examples of tree resistance include red maple resistance to attack from forest tent caterpillars, and the resistance of some elm trees to attack by *Scolytus multistriatus*. Many other examples are known. Biochemical knowledge of the insects' requirements and why the trees are not providing this has important implications. It was also brought out that in a graduate study using pine seedlings and sawflies, fertilization of the seedlings caused the trees to become toxic to the sawflies feeding on them. Tree breeding for resistance to insects was considered very important but the reasons for the "resistance" had to be known first.

The importance of site and resultant tree vigor as it affects damage by insects was discussed in detail. This led into a debate on whether bark beetles cause tree mortality or whether they are symptoms of dying trees. Arguments on both sides presently lack evidence.

It was agreed by everyone voicing an opinion that more attention needs to be given tree physiology in our work. How this should or could be done was not apparent. Several members stated that even if physiologists could be hired to work on our problems, the entomologist would have to work closely with them. Perhaps the solution includes entomologists trained in other fields such as biochemistry and plant physiology.

Several members believed that attendance at short courses would be very helpful and that agencies should encourage and support this.

Work is planned on the physiology of tree resistance to insect attack at several Canadian and American laboratories. For example, resins and insect nutrition are studied at the Calgary Laboratory.

It was generally agreed that tree physiology was very important in forest entomology and that this should and will receive far greater attention in the future.

WORKSHOP: CONE AND SEED INSECT WORKSHOP

Moderator - Paul E. Buffam

This was the third consecutive Work Conference in which a cone and seed insect workshop was included in the program. Therefore, workers in this field treat this as an opportunity to discuss results of recent studies and plans for future work as well as the field in general. Therefore, the minutes of the workshop are primarily a review of recent work and future plans.

General

1. Boyd Thomas is working on the taxonomy of the genus Conophthorus and asked for various participants to send specimens to him.

2. Jack Schenk suggested that a method is needed to allow the forester to forecast seed crops and the ensuing insect populations. This information would help determine whether control is needed. The group agreed that such a technique would be valuable.

3. Economics of control were discussed. John Zingg stated that if the cost of spraying a single Douglas-fir tree bearing 1 bushel of cones was $1, an increase in yield of 2 seeds per cone would pay for the treatment.

4. A cone and seed insect newsletter containing results of recent damage surveys and studies and proposed plans is distributed periodically. Contact Al Hedlin to have your name placed on the mailing list.

5. The major emphasis in cone and seed insect work in the past year has been in control. Work was done mainly on three species, Douglas-fir, ponderosa pine, and western white pine. Highlights of recent work and planned studies are categorized by these species.

Douglas-fir

Recent work.--Spray tests were made last season to determine the effectiveness of several insecticides against primary Douglas-fir cone and seed insects. Good control of the cone midge Contarinia oregonensis and cone moths were obtained with bidrin, dimethoate, and meta-systox R when materials were applied to run-off. This test was made by Johnson and Meso at three locations in Oregon and Washington. Results of a helicopter application of dimethoate in Oregon were inconclusive because of low insect populations. However, this control approach appears promising (Meso).

A guide for control of Douglas-fir cone and seed insects has been written by Al Hedlin and Norm Johnson and will be released soon as a Canada Department of Forestry leaflet. This guide lists recommendations and precautions for the use of bidrin, dimethoate, and metasystox R. The guide is written so that the user can decide which of these three materials he should use for his particular situation.

Future plans.--(1) Al Hedlin is working on factors affecting diapause of cone and seed insects. (2) Jack Schenk is working on biology and control of cone and seed insects in Idaho. He would primarily like to find a silvicultural control method or to combine chemical control by trunk implantation with silvicultural control. (3) Tom Koerber and Stan Meso will run a cooperative test in southern Oregon to compare a soil treatment of lindane with a mistblower or helicopter application of dimethoate directly to the cone bearing region of the trees. Treatments will be aimed to control the cone midge. An economic analysis will be made of the two methods.

Ponderosa Pine

Tom Koerber ran a control study in California in 1965 in which he treated individual cone clusters with DDT, diazinon, Zectran, and Guthion. Protection against *Laspeyresia* was insufficient but Guthion and Zectran gave effective protection against *Conophthorus*. This study will be repeated in 1966 with efforts made to treat near the beginning of *Laspeyresias* oviposition period.

Koerber has found two species of Xyelid sawflies and one species of weevils that cause damage to staminate cones of ponderosa pine. Damage by the sawflies is probably insignificant.

Western White Pine

Work in western white pine in Idaho has been completed. Jack Schenk has found that seed losses increased with decreasing stand density. This is an important point to consider when establishing seed production areas in white pine.

WORKSHOP ON LABORATORY DESIGN

Moderator: F. H. Schmidt

The workshop (No. 3) in Laboratory Design convened with 12 members attending. Since a tour of the Forest Research Laboratory preceded the workshop and the members were conducted on the tour in a separate group, it was thought that the tour itself could speak more eloquently than the workshop members without supplemental visual aids. An additional hour was, therefore, spent on the tour, during which time we were able to discuss certain attractive and unattractive design features of individual laboratories and rooms with their occupants as well as among ourselves.

In the ensuing discussion, it was unanimously felt that the first and foremost consideration in designing a laboratory is to provide for maximum flexibility and future growth. Thus, in stage-wise construction plans, it would be deisrable to over-design in the first stage of construction to avoid duplication in subsequent stages. This could be done by either installing equipment, such as a still or a vacuum pump, with a capacity much greater than would be required in stage 1, or by leaving space in the mechanical rooms for additional supplemental equipment.

No agreement could be reached within the panel as to the kinds of rooms and offices that would be most desirable in a laboratory. Nor could agreement be reached on satisfactory sizes and arrangements of these rooms and offices within the buildings. These would all be contingent on the kind of research program to be considered, the staffing, the degree of specialization of the staff members, anticipated growth of the laboratory, and many other factors.

The inclusion and size of certain support facilities, such as an auditorium, a library, conference rooms, a coffee shop or cafeteria, etc., should be dependent on the proximity and quality of similar existing facilities. In other words, don't provide for a sizable library, for example, if the laboratory is to be located down the block from an excellent university or public library.

Thought should be given to the placement of facilities so as to increase their own usefulness and to decrease any potential hazards. The placement of a radioactive isotope laboratory in the basement of a building, for example, will often result in the filtering out of "background noise," thus increasing the effectiveness of the isotope counting operation. Care should be taken to minimize the hazard of bulk-storing of inflammable, toxic, and corrosive chemicals.

The usual utilities should be provided in all laboratories needing them. These include hot, cold, and distilled water, steam, gas, vacuum, 110 v., 220 v., and fume hoods. The need for very many gas outlets in most laboratories was questioned.

Perhaps one of the most surprising results of the workshop was the fact that air-conditioning of the laboratories, even those in which insects were used in bioassay work, was not unanimously endorsed, although it was recommended by the majority in the workshop. Temperature controls from $\pm 0.5^\circ$ to $\pm 1.5^\circ$ C. were recommended, although controls less than $\pm 1^\circ$ C. might not be worth the added cost. Temperature controls in insect rearing rooms should be about $\pm 0.2^\circ$ C. Humidity controls were thought desirable in laboratories located in the dry plains states and provinces. These and insect rearing rooms should have controls of $\pm 5\%$ R.H.

The most satisfactory and recommended way of designing and building a laboratory is through a local architect with whom all of the laboratory staff members should consult. The closer and the more continuous this association is, the more satisfactory and functional will be the completed laboratory.

WORKSHOP ON SUCKING INSECTS

Moderator: J. A. Rudinsky

THE BALSAM WOOLLY APHID

By M. D. Atkins

The workshop opened with agreement among the 13 participants to confine the discussion to the Balsam Woolly Aphid, a mounting problem in western North America.

An outline of the extent of the infestation and the hazard at hand in British Columbia and the Pacific Northwest was presented. In British Columbia the aphid has developed two main infestation areas. On the east coast of Vancouver Island it infests *Abies grandis* growing mainly in farm wood-lots and recreational areas. Around Vancouver on the mainland the infestation occurs primarily on *Abies amabilis*. The hazard in the British Columbia region lies in the possibility that the aphid could spread to high value stands of *A. amabilis* growing in the central portion of Vancouver Island or into extensive pulpwood stands of *A. lasiocarpa* in the northern part of the province.

In Washington and Oregon, the aphid has been present for a longer period and now infests *Abies* throughout its range. It appears, however, that *A. grandis* has been a major factor in the spread and present distribution of the insect. In commercial stands, infested areas are clearcut and replanted with Douglas-fir below 2500 feet. Above 2500 feet *Adelges* induced mortality is lower but when replanting is required *A. procera* is the replacement species. The main hazard and management problem in the Pacific Northwest is the vast area of recreational land stocked with *A. lasiocarpa*. Relatively little research has been conducted on the Balsam Woolly Aphid in western North America. However, in the United States, the emphasis has been placed on the life history, methods of dispersal, host response, symptomology and rate of death. Only fragmentary studies have been conducted in western Canada.

Surveys of native predators in the west have not turned up any promising species and to date introductions of exotic species have produced poor results.

A review of the attack pattern, damage and mortality of the three host species in the west may be generalized as follows:

A. lasiocarpa - trees 18-20 years and older growing on good sites are most susceptible. The infestation seems to progress from the top down with mortality occurring in 1-3 years.

A. amabilis - trees 60 years old to mature on good sites most susceptible. The infestation progresses from the top downward with mortality occurring after 5-7 years of infestation. Gouting is often severe and recovery may be accompanied by bushy top-growth.

A. grandis - trees 25 years and older susceptible. The infestation seems to move upward from the base of the crown. The infestation is often very heavy on the stem and branches and may persist for many years before mortality occurs. Gouting often less apparent than on A. amabilis but flagging tops are common.

Since a research program is being started in the British Columbia region the workshop outlined the following important areas for future investigation.

Variations in the life history in relation to area and host species.

A more thorough investigation of dispersal mechanisms.

Comparative studies on tree resistance and susceptibility.

It was suggested that physical as well as biochemical indicators of susceptibility should be examined.

Finally, it was recognized by the workshop that the main problem confronting interested parties in the Pacific Northwest is apathy. The Balsam Woolly Aphid is well established and recognized as a pest that will continue to cause severe damage to commercial and recreational forests. The workshop urged that the public and research agencies should be made aware of these facts and that research on the aphid be expanded wherever possible. It was also recommended that the Pacific Northwest Pest Action Council be urged to reactivate their committee on the Balsam Woolly Aphid.

WORKSHOP ON EUROPEAN PINE SHOOT MOTH

Moderator: A. A. Berryman

The discussion in this workshop centered around survey and quarantine, progress and problems of artificial rearing and sterile male research and problems important to the eradication program in Washington.

Status of EPSM in the West.

The range of EPSM in the west has changed little in the past year. The insect is restricted to coastal areas of Washington and British Columbia, and interior British Columbia. It attacks ornamental pines of all species and, except for two isolated examples, does not seem to do well in native stands. EPSM was found in native lodgepole pine in the Puget Sound area and in ponderosa pine in interior British Columbia. Failure to find it more regularly in native stands may be due to survey difficulties rather than the absence of the insect. Possibilities exist for using sex attractant as a survey tool in native stands.

Containment of EPSM in the Puget Sound area seems to have been fairly effective to date. Several escapes into Oregon and interior Washington in the past year were detected and the infested trees destroyed. Were all escapes detected? Escape into interior British Columbia was via infested nursery stock; this seems the usual method of spread. Movement of infested nursery stock is difficult to control, particularly in private cars. Public education is, therefore, a necessary part of a quarantine program.

The eternal question, "Is EPSM a pest?" was discussed again. EPSM is not a severe problem on ornamentals or Christmas trees where they are controlled by shearing practices. The panel generally agreed that this question is impossible to resolve if unknown future values are considered, particularly as some introduced pests have taken many years to reach economic status. It was pointed out that EPSM was much more aggressive in the Seattle area than in British Columbia and that the insect might be present in low numbers in native stands, ready to explode under favorable conditions. Assuming that EPSM is a pest until it is proved otherwise, seems the safest approach.

The potential of EPSM to invade native stands is being investigated at the Vernon laboratory. Young, transplanted ponderosa pines were infested in cages containing adult moths. Larger trees were also infested by caging branches. The results of these tests should give valuable information on the pontential of EPSM to invade the interior ponderosa pine type.

Status of EPSM research.

1. Artificial rearing - Drs. Harwood and Chawla at W.S.U. have found that a modification of Berger's diet, incorporating less salt and more cellulose, forms an efficient growth medium. Autoclaving the diet seems to improve the constituence of the diet and reduce mold formation. Work is now centered around mass rearing.

2. Sterility techniques - (Berryman, Taylor, Shen) Preliminary studies established that old pupae (11-12 days) are more resistant to radiation than younger individuals. EPSM pupae can withstand doses of 50,000 rads with no appreciable effects on pupal mortality or adult longevity.

   The effects of irradiation on fertility and male competitiveness have, as yet, not been resolved due to difficulty in obtaining mating in the laboratory. Mating behavior is extremely complex; some of the factors involved are temperature (19-21° C), humidity (50% RH), wind direction, and light quality and quantity. Even when these factors are manipulated no more than 20 percent mating is obtained.

   Work is also in progress using TEPA as a sterilizing source. The effects of treatments on the microscopic level are also being investigated.

3. Mating behavior - (Daterman) Field studies have been carried out on factors affecting mating and sex attractant. The U. S. Forest Service has now obtained permission to import EPSM, under quarantine conditions, to Corvallis where further studies will be persued in the laboratory.

Eradication problems.

It was generally agreed that eradication of EPSM from western Washington is possible, but that the task will not be easy. Eradication by host elimination and sterile male release were discussed, but it was generally agreed that legal and public relations difficulties made the former method impractical. Some of the problems of erradication by sterile male release are:

1. Necessity for maps of host tree distribution for release scheduling.

2. Sampling techniques necessary for estimating absolute populations so that rearing and release requirements may be determined. The easiest sampling stage is probably the pupa after emergence of the moth. However, sampling of the overwintering larva would give more time for rearing and release scheduling.

3. Public relations problems in releasing large numbers of insects in urban districts.

4. Mechanical problems of releasing insects when host tree has a very uneven distribution.

    a. Work on the flight capabilities of males and the distance that the sex attractant can be perceived is necessary to determine how far from infestation sterilized males may be released.

5. Long flight period necessitates continuous and highly synchronized rearing program.

It was generally agreed that eradication offered great advantages, not only in the elimination of the insect from Washington, but as a tool to prevent reestablishment and for eradication attempts in other infested areas.

SUMMARY OF WORKSHOP ON WEEVILS

Moderator: S. F. Condrashoff

Weevils are essentially pests of seedlings and young stands, although they may affect trees up to 30-40 years old.

Steremnius carinatus, which ranges along the west coast from Alaska to Oregon and occurs in the interior wet-belt in British Columbia, girdles young plantation and regeneration coniferous seedlings in damp, cool west coast sites. The damage is done in the adult stage, during spring and autumn, the summer being spent mainly in breeding activities. Adults are flightless and live three or more years. Population buildup results mainly from logging activities, broods being established in roots of stumps and in buried slash. Damage to seedlings is intensified by elimination of natural vegetation by burning which is necessary to reduce brush competition for seedlings. As broods require about 18 months to develop, and seedlings are no longer subject to attack a year following planting, burning and planting immediately following logging is recommended to avoid damage. Older seedlings are less attractive and may be planted in high-hazard areas. The trend to using older seedlings generally should reduce weevil damage and may eventually eliminate the problem.

Hylobius warreni, which is distributed transcontinentally, girdles and kills spruces and pines 8-10 years old in the larval stage, and also attacks trees up to 40 years old, causing reduction in growth. Larvae require two years to develop and adults, which are flightless live for three years. This weevil is mainly a regeneration problem, but is especially severe when encountered in plantations. Up to 60 percent mortality has occurred in Scotts pine. The main foreseeable hazard may be to regeneration where strip-cutting logging programs are undertaken. However, this problem may be eliminated by cutting the residual stands before reproduction attains 8-10 years of age. Control would be exercised by elimination of breeding material for a 5-6 year period in order to decimate the weevil populations.

Cylindricopturus eatoni is a plantation and seedling-bed pest in California. This weevil is a strong flier and attacks ponderosa pine and other pines. Larvae girdle trees up to 3-4 feet tall and mine the pith. High mortality due to this insect is probably associated with artificial conditions in the situations where it is a pest. Studies in depth would be required to elucidate factors that result in buildup of populations. Suggested control was removal and destruction of affected trees. In some situations aerial application of DDT was successful.

Pissodes terminalis, *P. sitchensis* and *P. strobi* are terminal feeders. Damage is generally tree deformity resulting in suppression of growth and reduction in timber quality. *P. terminalis* is a high-elevation species, and may assume importance as a pest of pulp timber. There is no effective control of the weevils, except for avoidance of plantation-type of non-shaded conditions.

Generally, a greater understanding and appreciation is required of the significance of the weevil species in relation to economics of timber harvest, effects on watershed, recreational and aesthetic value, etc., in the consideration of control programs and studies. In the past some values have been overemphasized and others received inadequate attention.

These insects appear to be especially amenable to control by silvicultural means. Future studies may well be directed to that end.

WORKSHOP ON INSECT ATTRACTANTS

Moderator: G. B. Pitman

At the onset of the workshop an attempt was made to orient the discussion toward the application of insect pheromones as potential population manipulating agents. As evidenced by the response of the 18 participants, a deficiency exists in definitive data necessary for the successful implementation of forest insect attractants. However, the participants were able to define some of the areas where work was needed and these included insect behavior, weather, attractant determination and bioassay.

Insect behavior.

From studies on the attractant of *Trypodendron lineatum* John Chapman found that released beetles dispersed rapidly and were soon beyond the effective range of an attractive trap before they were prepared to respond. This type of behavior emphasized the problem of correctly interpreting results from studies concerned with the response pattern of flying beetles. The question of beetle behavior was considered further in a brief discussion on beetle dispersion, i.e., do beetles continue to search for the attractant, or, in its absence are other stimuli operative in directing flight? It was the concensus that more field work is needed, particularly of the nature designed to define the parameters governing the various aspects of beetle behavior.

Weather.

Chapman's work with *T. lineatum* also served to illustrate the importance of weather on beetle behavior. It was determined that the bimodal response pattern characteristics of *T. lineatum* and other bark beetles is not a total temperature dependent phenomenon. The intensity of the convection currents is apparently an important variable. In the early morning and evening the air is comparatively still, thus facilitating the odor bloom capture by the flying beetles. The use of smoke was suggested as a possible technique for investigating the dispersion of attractive volatiles under field conditions.

Attractant determination.

Considerable attention was given to the problem of isolating and identifying insect attractants. The major difficulty, particularly in the area of identification, stemmed from the small amount of material available for chemical analysis. In order to circumvent this problem, R. Wright of the British Columbia Research Council suggested that candidate compounds be screened for their ability to attenuate the insect attractant. Wright indicated that the degree of difficulty would be less in locating attenuating materials than isolating and identifying the pheromone for each forest insect species. The application of such attenuating materials might serve to mask the natural attractant, thereby blocking mechanisms that control such phenomena as mate finding and host selection.

A technique for isolating and "finger printing" bark beetle attractants was outlined. With gas-liquid chromatography the Boyce Thompson Institute has been able to characterize the attractant(s) of *Ips confusus*, *Ips plastographus*, *Ips pini*, *Ips calligraphus*, *Ips montanus*, *Dendroctonus ponderosae* and *Dendroctonus brevicomis*. The technique involves the extraction of volatiles from nearly pure fecal material.

It was reported by several members of the workshop from the University of California that work is well advanced in isolating the attractant of *Hemerocampa pseudotsugata* (Douglas-fir tussock moth).

Bioassay.

The need for an accurate and reliable bioassay was considered to be an absolute must in investigating insect pheromones. L. Brown of the University of California stated that work on the Neodiprion abietis complex was impaired as a result of the lack of a satisfactory technique to assay the attractant under laboratory conditions.

Note: Although only a few participants were mentioned specifically the moderator gratefully acknowledges all those who contributed to the workshop discussion.

PANEL: CLIMATE AND DEFOLIATORS

Discussion Leader - B. E. Wickman

Abstract

Influence of Climate Upon Population Trends of the Lodgepole Needle Miner

By R. F. Shepherd

Four factors which influence the increases and decreases of needle miner populations were correlated with population trend for one plot. Of these, the changes during oviposition and egg hatch had the highest correlation, greater than winter mortality, parasitism, or number of parents initiating each generation. The influence of weather upon oviposition was described in some observations relating catch of moths in whirling traps to light, temperature, rain, and wind. The total seasonal degree hours during the daily period of greatest moth activity following each sundown was correlated with seasonal trend for one plot and was found to be high. These studies indicate how weather can influence the moth's ability to lay a full complement of eggs.

THE EFFECT OF UNFAVORABLE SUMMER WEATHER CONDITIONS ON THE LODGEPOLE NEEDLE MINER IN YOSEMITE PARK

By T. W. Koerber for G. R. Struble

Since 1947 we have had an outbreak of the lodgepole needle miner in high-elevation lodgepole pine forests of Yosemite Park in California. George Struble has been studying this problem since 1954, and I am sure most forest entomologists in the West are familiar with the problem. Part of this population was the subject of some controversial chemical control operations, but most of the infested area was left undisturbed, thus providing an opportunity to study the action of natural control factors.

There was evidence that two previous outbreaks in the same area ended abruptly. In 1946, a lodgepole needle miner outbreak in the Banff area of Alberta was sharply checked by extreme winter cold. Consequently, all hands eagerly awaited the confidently expected crash of the Yosemite needle miner population. By 1963 the infestation covered 89,000 acres, and 20,000 acres of lodgepole pine forest were dead or nearly dead. Parasites, predators, and diseases did not make a very impressive dent in the population, and winter temperatures were not low enough to duplicate the Banff situation.

During the summer of 1963 the weather was a bit cooler than normal during the period of late larval and pupal development. This delayed adult emergence and oviposition about 2 weeks. Egg hatch, which was normally completed by September 20, was still incomplete on October 15. Larval establishment checked in the spring of 1964 was 77 percent below the previous generation. In the summer of 1965 cold weather again delayed development. This time adult emergence and oviposition were a full month later than normal, and none of the eggs collected in late October had hatched. We seriously doubt that the eggs were able to hatch before the onset of winter weather or that they will survive until spring.

Several questions arise from these observations. How cold was it? for how long? and what is "normal?" A check of the U.S. Weather Bureau statistics for Hetch Hetchy and Yosemite Valley, the two closest stations, revealed that in 1963 June, July, and August mean temperatures were 3 to 5 degrees below long-term means. In 1965 at the same stations monthly means were below normal from May through September. Departures from long-term means ranged from 1 to 6 degrees. Unfortunately, these stations are 4,000 feet or more lower than the infested forest. However, the short-term weather records from Tuolumne Meadows in the infested area show that in both 1963 and 1965 daily mean temperatures during June and July were 4 to 5 degrees below the comparable mean temperatures in the periods 1957 to 1961. Using temperature data for 1961 and 1965, we computed cumulative degree days at Tuolumne Meadows, using a low temperature of 40° F. Because of deep snow the area is inaccessible before early June, so temperature data for April and May was not available. Nevertheless, using June 1 as a starting date, degree-day accumulation in 1965 was 200 degree days below 1961 by mid-July when emergence normally occurs.

Here is an insect which, by any measure of success, has been very successful. For 15 years it maintained tremendous populations over a large and continually expanding area. Now a rather small reduction in average temperature appears to have pushed it to the verge of extinction. Presumably some will survive in especially favorable situations. It will be interesting to see how and where the species survives. I am very impressed by the drastic effect of this small change in weather conditions, for it indicates to me that apparently well-adapted insects may, in fact, lead a rather precarious existence.

WORKSHOP ON "INTERRELATIONS OF FUNGI AND BARK BEETLES"

Moderator: J. A. Chapman

It was reported that a summary (including recent key references) of the current status of this field had been presented at the 1965 Western International Forest Disease Conference, Kelowna, British Columbia, and would appear in the proceedings of that conference.

Knowledge of ambrosia beetle-symbiotic fungus relationships has recently increased rapidly. Distinct structures (mycangia) within the beetles, containing fungus spores, have now been found in perhaps 40-45 species and at least 8 locations in the insect body are involved. Mycangia found to date have been restricted to one sex, generally female, but male in some species. They are almost always clearly associated with gland cells. By 1963 the fungi of 33 ambrosia beetles had been investigated; in 15 of the associations an identification of the fungus has been reported, and 9 genera of fungi have been involved. It is believed that from an evolutionary standpoint scolytid beetles invaded wood only after fungus growth had made nutritional substances more available, and that these insect-fungus symbiotic relationships have had a polyphyletic origin, having arisen independently in several instances. The ambrosia fungi are considered closely related to the "blue-stain" fungi, and like them are wood cell content feeders, not true decay organisms (cell wall feeders).

There has been a long-standing interest in bark beetle- blue stain fungus associations, and a few careful studies in North America and Europe have been carried out. E. Wright concluded that a true symbiotic relationship existed between *Scolytus ventralis* and a *Trichosporum* fungus. Blue-staining of lumber is an economic problem in Sweden and elsewhere in Europe. There has been uncertainty as to the role of blue-stain fungi in helping beetles kill healthy trees: some workers have felt they assisted the beetles, others that the beetles could kill trees without the fungus. A large variety of fungus species have been found to be carried externally, as spores, by bark beetles and this has complicated this type of study. Recently Mathre in California intensively studied blue-stain fungi in relation to *Ips* and *Dendroctonus* and this work was summarized by G. Pitman. *I. confusus*, which may be classed as not very aggressive, is consistently associated in ponderosa pine with *Ceratocystis ips*, a vigorous parasite. *D. brevicomis*, an aggressive beetle is consistently associated with *C. minor*, a less vigorous species than *C. ips*. Even when these beetles overlap in their attack distribution, their fungus associates remain the same and distinct. *C. ips* and *C. minor* can both kill trees without the beetles, when innoculated artificially. It is believed that the fungi assist the beetles by helping protect, by their rapid growth, the vulnerable 1st instar larvae from resin-caused mortality. It is thought that these insect fungus relationships are non-obligate.

Mr. Shrimpton reported on the Calgary studies centering on the mountain pine beetle- lodgepole pine- blue stain relationships. A complex of micro-organisms has been found associated with the attacks of this insect: Ceratocystis montia and Euphorium sp. are found consistently 2 - 3 other fungi are quite frequent, 2 - 3 yeasts are present and several bacteria common. No definite conclusions have been reached on the nature of the beetle fungus relationships, but it has been found that multiple innoculations of the fungi can produce the same effects on trees as beetle attacks. The growth of the fungi in sapwood is very rapid, along rays and vertically - so rapid that vertical spore transport is suggested. Trees are stimulated by either beetle attack or fungus innoculation to produce more resin. Some trees are resistant, others are susceptible.

Francke-Grosmann has recently (1965) reported finding a distinct mycangium in a European Ips, long known to be associated with blue-staining. She assumed that this structure indicates a long-standing symbiotic relationship between beetle and fungus. By letter she reported finding a distinct mycangium in D. frontalis, often reported to be associated closely with a blue-stain fungus.

S. H. Farris reported finding mycangia in various bark and ambrosia beetles and showed illustrations of these structures. Mycangia were found in Gnathotrichus retusus and sulcatus (coxal cavities of male), in Monarthrum scutellare (coxal cavities of female) pronotal pits of female Platypus wilsoni, in head of both male and female Dryocoetes confusus. He reported two kinds of spores with respect to staining and bi-refrigence (optical activity) within some mycangia. Dendroctonus obesus, D. pseudotsugae and D. ponderosae have been examined for mycangia. None have the type of mycangium found in D. frontalis (which was confirmed by Farris). However, various pockets and concentrations of fungous material were found in specimens of these three species, although not consistently. Further work will be necessary before final conclusions can be made.

N. Johnson reported a marked difference in deterioration rate in windfalls of two different years. Where there were few or no beetle attacks, windfalls remained "fresh" through the next winter and into the second spring; where beetle attacks were common, deterioration was marked by that autumn.

A. Funk, forest pathologist, reported that the spore producing mechanisms of the blue-stain fungi as a group were not adapted for wind or water transport but were well adapted for insect transport (sticky spores).

O. Zethner-Moller reported that in Sweden felled logs were sprayed to prevent attack of Blastophagus bark beetles, the real reason being to keep the blue-stain fungi, that normally accompany the insect, from developing.

It was pointed out that there are a number of important biological questions still to be answered in this field.

WORKSHOPS ON AERIAL SURVEYS, TECHNIQUES, AND TRAINING

Moderator: Peter W. Orr

Workshop sessions on the three topics were combined at the request of the members. The following is a brief resume of each:

1. Techniques - The use and objectives of ground plots for detection and evaluation surveys were discussed. The theory, establishment, and maintenance of random permanent plots were discussed. There was general agreement that random plots data were efficient when habits of the insect population are fairly well known and where chronic problem areas exist.

   Most sample plots were established to follow the trend of defoliator populations.

   Helicopter use for sampling twigs in the tops of trees was discussed by John F. Wear. He pointed out that about 45 samples could be taken in two hours time. It is not known if insect-infested foliage could be collected in this fashion without dislodging larvae. It might be useful for egg surveys.

   Use of various rifles and shotguns for cutting sample branches has been only partially successful. This type of sampling is generally best in winter when twigs are brittle.

   Marking plot corners with fluorescent paint from a helicopter has been successful. A pint of paint marks one corner tree. The paint remains visible for several months.

   Double and triple sampling systems for use on both beetle surveys have proven satisfactory in the Pacific Northwest. Sampling errors of 13 percent for number of infested trees and 16 percent for volume of infested trees have been obtained. The systems have been used on Douglas-fir beetle and western pine beetle surveys. It was also used on a survey of balsam woolly aphid damage in 1957 in Washington.

   The properties of various color films for use on insect surveys were discussed. Large-scale photos are essential regardless of film type. In general, choice of camouflage detection or straight-color films is a matter of interpreter preference, especially in coniferous stands. CD films may enable the highly experienced interpreter to detect signs of mortality before it is evident on color film. CD films may be more productive with broad leaves.

   Tests of various film for mistletoe surveys showed that color and camouflage detection films were about equal in quality rendition.

2. Aerial Surveys - Choice of aircraft for aerial detection surveys varies widely depending upon height of flight, region, terrain, flight duration, rental costs, etc. The Beaver is one of the preferred float planes. The Cessna 180 or 185 are preferred for high country work. Cessna Sky Master is used for photos and surveys by one company.

   Length of survey flight varies from two hours in one region to about six hours in others. Observer efficiency generally decreases with the length of flight.

   A new lightweight magnetic belt voice recorder has proven satisfactory on aerial surveys. The recording quality is good. Observations on the belt are keyed to locations on the survey map by symbols.

   Kind, scale, and type of aerial survey map depend upon a number of variables such as area covered, intensity of survey, economic importance of timber type, etc. Preferred map scales range from 8 miles = 1 each to 1/4-mile = 1 inch. Enlarged aerial mosaic (2X) photos are used for surveys on some private timberlands in Oregon and Washington.

3. Training - Workshop members stressed the need for more on-the-job training for survey personnel in all phases of detection and evaluation surveys.

   The need to keep colleges and universities informed of new needs in survey training for foresters was discussed.

ADVANCES IN FOREST INSECT CONTROL

MODERATOR: Amel E. Landgraf, Jr.

Seventeen members attended the workshop and all contributed in the report and discussion of the recent advances in forest insect control.

Since the advent of the pesticide controversy there has been considerable time, effort, and funds put into the search for insecticides that are extremely toxic to target insects but at the same time are less toxic to other forest inhabitants. This intensive search is beginning to pay dividends. Entomologists report they have now found several insecticides that are toxic to the primary target insect, the spruce budworm, but at the same time, they are less toxic to fish and wildlife. This past summer, 1965, the more promising of these, Zectran, was tested in Montana. Entomologists report that they achieved excellent control (spruce budworm mortality in the area treated averaged 97 percent) with an oil solution containing .12 pound of Zectran dissolved in .6 gallon of light cycle oil. The formulation was applied by helicopter at the rate of .6 gal./acre. Based on the results of this test, a larger test is being planned for this summer, June-July 1966. Two spruce budworm infested areas in Montana (totaling about 6,500 acres) and one in Idaho (of about 5,000 acres) will be treated with .15 pound of Zectran dissolved in one (1) gallon of deodorized kerosene and applied at the rate of one gallon per acre.

Zectran is more toxic to the spruce budworm than is DDT but at the same time it is less toxic to salmon and trout and readily breaks down into inert products. Unfortunately, this breakdown can be a disadvantage. For example, Zectran deteriorates rapidly when mixed with fuel oil thus making it impossible to use this economical solvent as a carrier. Of all the solvents tested so far, Zectran appears to be most stable when mixed with either light cycle oil or deodorized kerosene.

Another promising insecticide is Pyrethrum. Although this insecticide has been known and used for over a hundred years it was not, until recently, considered important in forest insect control. Pyrethrum has many of the attributes considered desirable in an insecticide. It is extremely toxic to insects yet essentially non-toxic to humans and other warm blooded animals and it readily breaks down into biologically inert products. Unfortunately, this breakdown can be too rapid, particularly when Pyrethrum is exposed to sunlight. This problem has been partially solved. Entomologists at the Pacific Southwest Station report they have recently developed a stabilized Pyrethrum formulation and are planning a 40-100 acre field test this coming summer.

Region 6 announced that they have developed a technique for efficiently marking tops of trees with a high visibility paint. The paint is applied from a helicopter and one pint is sufficient to adequately mark a tree.

Region 3 reported they have been testing the silvicide, cacodylic acid, (Ansar 160) to determine if it will kill bark beetle broods. They report they have had some success in killing broods of Dendroctonus adjunctus Hopk. providing the trees were treated while the insect was in the egg stage. They were not able to achieve the same results when treating trees infested with D. ponderosae, D. obesus, or D. pseudotsugae. Entomologists felt that the reason for the poorer results was due to the beetle broods being in the larval stage at the time the trees were treated. The developing blue stain and mining by the larvae probably prevented or impaired the upward translocation of the herbicide. Insect mortaility appears to be the result of a rapid moisture reduction in the inner bark and phloem. A tree injector was used to inject the acid into the tree. Injection points were spaced about two inches apart. Each tree received about 150 ml. of acid. In all cases the tree's foliage began to discolor within a few days after the tree had been treated.

Entomologists from the University of California report that they have successfully sterilized the California five-spined ips, Ips confusus (Le Conte) and this summer (1966) they are planning to release several hundreds of sterilized but otherwise sexually competitive males into a natural population. Since this insect is polygamous (usually one male to three females), this approach may be the ideal way to control its numbers. The test will be followed with a great deal of interest.

It was the consensus of the group that there is a serious need for more reliable procedures for evaluating insect infestations. Actually, we know very little about the biology, behavior and population dynamics of forest insects and their associates. This lack of knowledge limits our ability to accurately appraise the need for control or when to initiate or cancel a control project. The Canada Department of Forestry eastern provinces, are refining their spruce budworm evaluation procedures. They are now putting their egg mass data on IBM cards.

It was also the consensus of the group that land managers, entomologists, and economists need to work together in preparation of realistic Cost-Benefit evaluations. The group questions the advisability of suppressing insect outbreaks in deteriorating overmature stands of timber that are presently isolated and will be for x number of years in the future. In other words, what are we buying?

In closing, I want to emphasize that it is too easy, when jotting down comments made by others, to unintentionally misinterpret or misquote what was intended. Therefore, I take full responsibility for the reporting.

MINUTES OF FINAL BUSINESS MEETING

February 17, 1966

The Chairman, J. M. Kinghorn, called the meeting to order at 11 a.m. in the Georgian Lounge, Empress Hotel, Victoria.

1. Minutes

   The minutes of the initial business meeting were read by the Secretary-Treasurer, D. McComb moved their adoption. Seconded by R. E. Stevens. Carried.

2. 1968 Meeting Place

   Ron Stark extended an invitation to meet in California, possibly at the Alumni Center, Squaw Valley.

   R. Washburn moved that we hold the 1968 meeting in the California area. Seconded by D. Dotta. Carried.

3. Theme, 1967 Meeting

   Suggestions for the meeting there were:

   (a) Communications in forest entomology - A. Landgraf, R. Stark suggested that this was good but theme should be broader.

   (b) Role of forest entomology in the art and science of forest management - N. E. Johnson.

   (c) Integrated approach to problems in forest entomology - M. D. Atkins.

   It was generally felt that communications should be included in the general theme "The role of forest entomologists in the art and science of forest management."

4. Duration of Meeting

   Pros and cons of the 3 vs. 3½ day conference were discussed briefly. It was felt there were some advantages to both but the 3½ day meeting was favored.

5. Program

   Workshops were discussed briefly and it was felt that the time devoted to these should not be reduced. As some felt they were losing out by not being able to attend as many workshop sessions as they would like to, more time should be allowed for discussion of summaries at the general session.

Since the program theme for 1968 will be more of general interest, it was suggested by Stark that less time should be devoted to workshops, but that the Conference should return to its usual workshop format in the year following.

6. <u>Committee on Common Names of Western Forest Insects</u>

The report of this Committee was read by Chairman P. C. Johnson. David Evans has accepted the position of Chairman of the Committee for the coming year. P. Johnson and G. Struble, who retired from the committee will be replaced by M. M. Furniss and J. Schenk.

7. Chairman J. M. Kinghorn extended an invitation to any members who would be in Victoria following the close of the meeting to visit at the Forest Research Laboratory. He thanked A. Landgraf and N. Wygant for their assistance in connection with the 1965 meeting in Denver; also, those who helped with the 1966 meeting, particularly E. D. A. Dyer who was in charge of local arrangements.

8. <u>Report of Nominating Committee</u>

Bill Wilford presented this report.

Chairman	-	Dick Washburn	-	2 years
Sec.-Treasurer	-	Galen Trostle	-	2 years
Councilor	-	Bob Stevenson	-	3 years

D. Schmiege nominated A. Landgraf for the position of Chairman. Bob Stevens moved that nominations close. Seconded by Dave McComb. Carried.

In the election which followed, Dick Washburn was chosen for the position of Chairman. He thanked the group and asked for a show of appreciation to the outgoing executive.

Tom Koerber moved that nominations for the position of Secretary - Treasurer be closed. Seconded by D. McComb. Carried.

C. J. DeMars moved that nominations for position of Councilor be closed. Seconded by A. Landgraf. Carried.

9. <u>Ethical Practices Committee</u>

Following a lengthy report, Chairman C. J. DeMars appointed R. Reid to the position of Chairman of this committee.

The meeting adjourned at 12 noon.

WESTERN FOREST INSECT WORK CONFERENCE

EXECUTIVE MEETING

February 13, 1966

Members Present:

J. Schenk
A. F. Hedlin
E. D. A. Dyer
R. E. Stevens
G. T. Silver
J. Chassler
J. M. Kinghorn

1. Minutes:

The minutes of the Executive Meeting held at the Denver meeting were read and adopted on a motion by Schenk and Stevens.

2. Finances:

Local arrangements committee chairman Dyer summarized some of the major costs in connection with the current meeting, used as a basis for deciding on the registration fee of $4.00. He calculated that there would be a slight loss on the meeting. J. M. Kinghorn pointed out that students and technicians could register for $1.00.

3. Meeting Notices:

It was pointed out that some members felt there was insufficient time between notices being sent out and the meeting. Kinghorn stated that if members had been inconvenienced he accepted full responsibility.

4. Nominating Committee:

The chairman appointed Bill Wilford (chairman) Normal Johnson, and Bob Reid to the Nominating Committee. Vacancies to be filled are Chairman, Secretary-Treasurer and one Councilor.

Kinghorn appointed M. M. Furniss and J. Schenk to replace vacancies occurring on the Common Names Committee.

5. After some discussion, Schenk moved that the Education Committee be discharged with thanks to the committee members. Seconded by R. Stevens.

6. Meeting Places:

1967 - Las Vegas - was felt we should invite Mexican entomologists.

Also, we should invite pathologists to participate in a program which would include insect-fungus relationships

1968 - Berkeley was suggested as a possible meeting place.

There was considerable discussion regarding a possible combined entomology-pathology meeting in Tuscon but it was felt that difficulties such as time of year and program might make it more difficult than possible advantages would justify.

The meeting adjourned at 11 p.m. on a motion by Dyer and Schenk.

APPENDIX

ANNUAL REPORT FOR 1965-1966

Committee on Common Names of Western Forest Insects

Western Forest Insect Work Conference

Joint Conference Sponsorship

No further action was taken by the several forest insect work conferences to jointly sponsor common names of forest insects to the common names committee of the Entomological Society of America. The problem of gaining more favorable consideration by the E.S.A. committee for common names proposed by the forest insect work conferences is currently limited by rules under which that committee operates. To change these rules probably would require action by the E.S.A. executive board, action which might be urged by our Conference and the other work conferences together.

Committee Membership

Mr. Robert Stevenson, Calgary, accepted a three-year appointment to the Committee to replace Mr. Clifford E. Brown, Calgary, whose appointment terminated at the end of the 16th annual Conference on March 4, 1965.

Common Names of *Dendroctonus* Species

This Committee was directed at the 16th Conference to observe a moratorium on any action affecting changes in common names of western species of the genus *Dendroctonus* for a 5-year period from the publication of the generic revision by Stephen L. Wood, or from June 14, 1963. The Committee has observed this mandate.

In an unprecented action, the E.S.A. common names committee approved continuance of all common names for species of *Dendroctonus* recognized prior to Dr. Wood's revision. Common names currently approved by E.S.A. for western species of *Dendroctonus* are as follows: 1/

Scientific Name	E.S.A. - Approved Common Name
D. adjunctus (Hopkins)	Roundheaded pine beetle
D. brevicomis LeConte	Western pine beetle Southwestern pine beetle

1/ Blickenstaff, C. C. 1965. Common names of insects approved by the Entomological Society of America. Bul. Entomol. Soc. Amer. 11 (4): 287-320.

Scientific Name	E.S.A. - Approved Common Name
D. frontalis Zimmerman	Southern pine beetle Arizona pine beetle Smaller Mexican pine beetle
D. murrayana Hopkins	Lodgepole pine beetle
D. obesus (Mannerhein)	Sitka spruce beetle Alaska spruce beetle Engelmann spruce beetle Red-winged pine beetle Eastern spruce beetle
D. parallelocollis Chapuis	Colorado pine beetle Mexican pine beetle
D. ponderosae Hopkins	Black Hills beetle Jeffrey pine beetle Mountain pine beetle
D. Pseudotsugae Hopkins	Douglas-fir beetle
D. Punctatus LeConte	Allegheny spruce beetle
D. simplex LeConte	Eastern larch beetle
D. valens LeConte	Red turpentine beetle

New Common Names Approved by E.S.A.

The E.S.A. committee on common names of insects on December 7, 1965 unanimously approved the following common names previously approved by the Conference:

FIR TREE BORER for Semanotus litigiosus (Casey)

PINE NEEDLE-SHEATH BORER for Zelleria haimbachi Busck.

DOUGLAS-FIR CONE MOTH for Barbara colfaxiana Kearfott.

The E.S.A. disapproved by a 2-5 vote on that date the Conference-suggested name TERMINAL WEEVIL, thereby retaining the E.S.A. - approved name of LODGEPOLE TERMINAL WEEVIL for Possodes terminalis Hopping.

Conference Representation On E.S.A. Committee

The three-year appointment of Philip C. Johnson, Missoula, on E.S.A.'s committee on common names of insects expired December 2, 1965. Malcolm M. Furniss, Moscow, was appointed effective that date for a similar term on the E.S.A. committee, thus assuring continued representation of western forest entomology on that committee.

New Common Name Proposal

The name INCENSE-CEDAR WOOD WASP proposed January 6, 1966 by Boyd E. Wickman, Berkeley, for *Syntexis libocedrii* Rohwer was approved February 4 by a 6-0 vote of the Committee, one abstaining. Action of the Committee will be announced at the initial meeting of the 17th Conference on February 14. If no serious objections to the proposed common name are received within 30 days from that announcement, the proposal will receive Conference approval and be submitted to the E.S.A. committee on common names for its approval.

E.S.A. Adopts Conference Proposal Form

The Committee was gratified to learn through Conference Chairman Kinghorn on December 7, 1965, that the common names proposal form designed several years ago has been adopted for use, with minor modifications, by the E.S.A. committee on common names of insects.

Respectfully submitted,

COMMITTEE ON COMMON NAMES OF
WESTERN FOREST INSECTS

David Evans, Victoria (1967)
Philip C. Johnson, Missoula, Chm. (1966)
Donald A. Pierce, Albuquerque (1969)
Robert Stevenson, Calgary (1970)
George R. Struble, Berkeley (1966)
David L. Wood, Berkeley (1968)
J. M. Kinghorn, Victoria, ex officio
Donald A. Schmiege, Juneau (1969)

Missoula, Montana
February 7, 1966

REPORT OF ANNUAL MEETING

Committee On Common Names of Western Forest Insects

Western Forest Insect Work Conference

Victoria, British Columbia, February 14, 1966

The meeting was called to order at 9:15 p.m. in the Empress Hotel by Committee Chairman Philip C. Johnson. Committee members present were Chansler (vice Pierce), Schmiege, Stevenson, Wickman (vice Struble), Stark (vice Wood), and Kinghorn, ex officio. Committee members-elect present were M. Furniss and Schenk.

The Committee's annual report was read by the Chairman.

Brief discussion was held on the fate of the four common name proposals sent to the Committee On Common Names Of Insects of the Entomological Society of America during the past year; also on a new proposed common name received by the Conference committee during January.

Malcolm M. Furniss and John A. Schenk, both of Moscow, Idaho, and appointed by the Conference executive committee on February 13, 1966, to replace George R. Struble and Philip C. Johnson whose appointments with the Committee expire at the close of the 1966 Conference, were introduced and welcomed.

David Evans was unanimously elected to serve as chairman of the Committee for one year, or to the adjournment of the 1967 Conference.

The meeting was adjourned at 10:15 p.m.

Respectfully submitted,

COMMITTEE ON COMMON NAMES OF
WESTERN INSECTS

David Evans (1967)
Philip C. Johnson (1966) Chm.
Donald A. Pierce (1969)
Donald C. Schmiege (1969)
Robert Stevenson (1970)
George R. Struble (1966)
David L. Wood (1968)
J. M. Kinghorn (1966) ex officio

SEVENTEENTH ANNUAL WESTERN FOREST

INSECT WORK CONFERENCE

The sixteenth meeting of the Western Forest Insect Work Conference was held in combination with the Central International Forest Insect and Disease Work Conference at Denver, Colorado, March 1-4, 1965. The theme was "Reconciling insect control with the forest community." Conferees represented the following organizations:

American State and Federal governments	63
Canadian Federal government	16
Industry	15
Colleges and Universities	24
	118

The conference was attended by 41 people from groups outside the western conference area.

Proceedings were distributed to all who registered at the meeting. The complete mailing list now totals 224.

Thanks are extended to A. E. Landgraf, Jr., and E.D.A. Dyer for the excellent job of carrying out local arrangements for the 1965 and 1966 meetings, respectively. Also to the staff of the Forest Research Laboratory, Victoria, for assistance in typing and assembling the Proceedings.

Respectfully submitted,

/S/ A. F. Hedlin

A. F. Hedlin, Secretary-Treasurer,
Western Forest Insect Work Conference

FINANCIAL STATEMENT

WESTERN FOREST INSECT WORK CONFERENCE

as of February 9, 1966

		Expenses	Receipts
Balance on hand February 19, 1965			$ 241.53
Willson Stationery		$ 4.94	
Denver meeting (U.S. Funds)			$1,149.00
Hotel:			
Banquet (105 dinners)		624.75	
Coffee and cokes		228.09	
Phone		7.98	
Tip		10.00	
subtotal		$870.82	
Transportation			
Tours		72.00	
Arrangements Committee			
Phone		2.40	
Parking		21.20	
Complimentary lunches		8.00	
subtotal		$ 31.60	
Total expenses Denver meeting			974.42
Balance			174.58
			187.66 (Can. funds)
Victoria Box and Paper	$ 5.97		
E. D. A. Dyer	4.11		
Blanace on hand February 9, 1966			$ 414.17

Respectfully submitted

/s/ A. F. Hedlin

A. F. Hedlin, Sec. - Treas.
W.F.I.W.C.

FINANCIAL STATEMENT

Western Forest Insect Work Conference
as of April 1, 1966

Balance on hand February 9, 1966		$ 414.17
Expenses		
Coffee Service	$ 111.50	
Banquet	406.09	
Gratuity	50.00	
Typewriter rental	6.13	
P.A. System	30.00	
Room for executive meetings	68.59	
Transportation to Forest Research Lab	38.00	
Entertainment at banquet	40.00	
Amplifier rental	6.50	
Coffee at Forest Research Lab	8.00	
Gratuity for stenographic work on Proceedings	10.00	
Charge to close out and transfer Bank Account to new Sec. - Treasurer	2.20	
	$ 777.01	
Receipts		
Registration and Banquet		749.12
		$ 386.28 (Can. funds)
Balance		$ 375.25 (U.S. funds)

/S/ A. F. Hedlin

MEMBERSHIP ROSTER

WESTERN FOREST INSECT WORK CONFERENCE

Note: Active members registered at the Conference in Vancouver B.C., March 1-4, 1966, are indicated by an asterisk.

A. WESTERN MEMBERS

ALLEN, DR. GEORGE A.
(Director)
Weyerhaeuser Research Center
P. O. Box 420
Centralia, Washington 98531

AMEN, CLARK R.
American Cyanamid Co.
1445-14th Place
Corvallis, Oregon 97330

*ASHRAF, MUHAMMAD
Department of Entomology
Washington State University
Pullman, Washington 99163

*ATKINS, DR. M. D.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

AVERELL, J. L.
(Forester)
U. S. Forest Service
630 Sansome Street
San Francisco, California 94111

BAILEY, WILMER F.
(Forester)
U. S. Forest Service
13429 W. 23rd Place
Golden, Colorado 80401

*BAKER, BRUCE H.
(Entomologist)
U. S. Forest Service
Box 1631
Juneau, Alaska 99801

BALDWIN, PAUL H. (DR.)
(Zoology Professor)
Colorado State University
Fort Collins, Colorado 80521

BARR, DR. W. F.
(Professor)
University of Idaho
Moscow, Idaho 83843

BEDARD, DR. W. D.
(Entomologist)
Pacific Southwest Forest and Range Experiment Station
P. O. Box 245
Berkeley, California 94701

*BELLUSCHI, PETER
Weyerhaeuser Research Center
P. O. Box 420
Centralia, Washington 98531

*BERRYMAN, DR. ALAN A.
(Assistant Professor)
Department of Entomology
Washington State University
Pullman, Washington 99163

*BILLINGS, RONALD F.
Entomology Department
Oregon State University
Corvallis, Oregon 97331

*BLOMSTROM, ROY N.
(Forester)
U. S. Forest Service R-5
7847 Eureka
El Cerrito, California 94530

BORDEN, TOM B.
(State Forester)
Colorado State Forest Service
Colorado State University
Fort Collins, Colorado 80521

BORG, THOMAS K.
(Student)
121 E. Lake
Fort Collins, Colorado 80521

BRIGHT, DONALD E., JR.
(Student)
University of California, Berkeley
259 Wilson Street
Albany, California 94706

BRIX, DR. HOLGER
(Plant Physiologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

BROWN, C. E.
(Entomologist)
Department of Forestry
102-11th Avenue East
Calgary, Alberta

*BROWNE, LOYD, E.
Department of Entomology and
Parasitology
Agriculture Hall
University of California
Berkeley, California 94701

*BUFFAM, P. E.
(Entomologist)
U. S. Forest Service
517 Gold Avenue S.W.
Albuquerque, New Mexico 87101

*CAHILL, DONALD B.
(Entomologist)
U. S. Forest Service
Missoula Equipment Development
Center
Missoula, Montana 59801

CAROLIN, V. M. JR.
(Entomologist)
Pacific Northwest Forest and
Range Experiment Station
P. O. Box 3141
Portland, Oregon 97208

CARPENTER, G. P.
(Research Representative)
Geigy Ag. Chem.
916 Deborah Dr.
Loveland, Colorado 80537

*CEREZKE, DR. HERBERT F.
(Entomologist)
Department of Forestry
102-11th Avenue, East
Calgary, Alberta

CHAMBERLIN, DR. W. J.
3320 Chintimini Avenue
Corvallis, Oregon 97330

*CHANSLER, JOHN F.
(Entomologist)
U. S. Forest Service
Denver Federal Center, Bldg. 85
Denver, Colorado 80225

*CHAPMAN, DR. JOHN A.
(Entomologist)
Department of Forestry
506 W. Burnside Road
Victoria, B.C.

COLE, WALTER E.
(Entomologist)
900 Athens Dr.
Apt. C
Raleigh, N. C. 27606

*CONDRASHOFF, SERGEI F.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B.C.

CORNELIUS, ROYCE O.
(Managing Forester)
Weyerhaeuser Company
Tacoma Building
Tacoma, Washington 98401

COULTER, WILLIAM K.
(Entomologist)
Pacific Northwest Forest and
Range Experiment Station
P. O. Box 3141
Portland, Oregon 97208

COX, ROYCE G.
(Forester)
Potlatch Forests Inc.
Lewiston, Idaho 83501

CROSBY, DAVID
(Entomologist)
U. S. Forest Service
Box 1631
Juneau, Alaska 99801

*DAHLSTEN, DR. D. L.
(Entomologist)
Div. of Biological Control
University of California
1050 San Pablo Avenue
Albany, California 94706

DAVIS, DR. DONALD A.
(Associate Professor)
Dept. of Zoology and Entomology
Utah State University
Logan, Utah 84321

*DeMARS, C. J.
(Entomologist)
Pacific Southwest Forest and
Range Experiment Station
P. O. Box 245
Berkeley, California 94701

DENTON, ROBERT E.
(Entomologist)
Intermountain Forest and
Range Experiment Station
Forestry Service Lab.
Box 468
Moscow, Idaho 83843

*DOLPH, ROBERT E., JR.
(Entomologist)
U. S. Forest Service
P.O. Box 32623
Portland, Oregon 97208

*DOTTA, DANIEL D.
(Forester)
California Div. of Forestry
State Office Bldg. No. 1
Room 354
Sacramento, California 95814

DOWNING, GEORGE L.
(Entomologist)
Pacific Southwest Forest and
Range Experiment Station
P. O. Box 245
Berkeley, California 94701

*DYER, E. D. A.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

EBELL, DR. LORNE F.
(Plant Physiologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B.C.

*EDWARDS, DR. D. K.
(Entomologist)
Forest Research Laboratory
Department of Forestry
506 W. Burnside Road
Victoria, B.C.

*EVANS, D.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B.C.

*FARRIS, S. H.
Department of Forestry
506 W. Burnside Road
Victoria, B.C.

FELLIN, DAVID G.
(Entomologist)
Intermountain Forest and
Range Experiment Station
Forest Service Building
Missoula, Montana 59801

FERGUSON, W. E.
(Associate Professor)
San Jose State College
San Jose, California 95114

*FISHER, ROBERT A.
(Product Manager)
Bioferm Div. I.M.C.
Bin B.
Wasco, California 93280

FLESCHNER, DR. C. A.
Dept. of Biological Control
University of California
Riverside, California 92507

*FURNISS, MALCOLM M.
(Entomologist)
Intermountain Forest and Range Experiment Station
Forestry Sciences Laboratory
P. O. Box 469
Moscow, Idaho 83843

FURNISS, R. L.
(Assistant Director USDA) (Retired)
Pacific Northwest Forest and Range Experiment Station
P. O. Box 3141
Portland, Oregon 97208

GERMAIN, CHARLES J.
221 Forestry Building
Colorado State University
Fort Collins, Colorado 80521

GOYER, RICHARD A.
College of Forestry
University of Idaho
Moscow, Idaho 83843

*GRAHAM, DR. KENNETH
(Prof. of Forest Entomology)
Department of Zoology
Biological Sciences Building
University of British Columbia
Vancouver 8, B.C.

GRAMBO, ERNEST J.
(Assistant Regional Forester)
U. S. Forest Service
Denver Federal Center
Denver, Colorado 80225

GROSSENBACH, PAUL A.
(Forester)
U. S. Forest Service
Forest Service Building
Ogden, Utah 84401

GUY, W. C.
(Photographer)
Pacific Northwest Forest and Range Experiment Station
P. O. Box 3141
Portland, Oregon 97208

*HALL, DR. RALPH C.
(Consulting Forest Entomologist)
72 Davis Road
Orinda, California 94563

*HALLING, C. S.
Department of Forestry
506 W. Burnside Road
Victoria, B.C.

*HAGLAND, HERBERT
U. S. Bureau of Land Management
P. O. Box 3861
Portland, Oregon 97208

*HARD, JOHN S.
U. S. Forest Service
Box 1631
Juneau, Alaska 99801

*HARRIS, DR. JOHN W. E.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

*HEDLIN, A. F.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B.C.

*HEIKKENEN, DR. HERMAN J.
(Professor of Forest Entomology)
University of Washington
Seattle, Washington 98105

HESTER, D. A.
(Forester)
U. S. Forest Service
Denver Federal Center, Bldg. 85
Denver, Colorado 80225

HOCKING, DR. BRIAN
(Head)
Dept. of Entomology
University of Alberta
Edmonton, Alberta

HOFFMAN, DONALD M.
(Associate Wildlife Biologist)
Dept. of Game, Fish & Parks
Box 307
LaVita, Colorado 81055

*HONING, FRED W.
(Entomologist)
U. S. Forest Service
Federal Building
Missoula, Montana 59801

HOPPING, GEORGE R.
Department of Forestry
Forest Research Laboratory
102-11th Avenue East
Calgary, Alberta

*HOUSE, Gordon M.
Department of Entomology
Oregon State University
Corvallis, Oregon 97331

*HOWARD, BENTON
(Forester)
U. S. Forest Service
P. O. Box 3623
Portland, Oregon 97208

JAENICKE, A. J.
2941 Mulkey Street
Corvallis, Oregon 97330

*JOHNSEY, RICHARD L.
Washington State Dept. of
Natural Resources
Route 4, Box 424B
Olympia, Washington 98501

*JOHNSON, DR. N. E.
(Entomologist)
Weyerhaeuser Research Center
P. O. Box 420
Centralia, Washington 98531

*JOHNSON, PHILIP C.
(Entomologist)
Intermountain Forest and Range
Experiment Station
Federal Building
Missoula, Montana 59801

KEEN, F. P.
1054 Oak Hill Road
Lafayette, California

*KIMMINS, J. P.
1734 Delaware Street
Berkeley, California 94703

*KINGHORN, J. M.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B.C.

*KINN, DONALD N.
(Student)
University of California
Department of Entomology
1038 9th Street
Albany, California 97710

KINZER, HENRY G.
(Entomologist)
New Mexico State University
University Park,
New Mexico 88070

*KLEIN, BILL
(Entomologist)
U. S. Forest Service
324 - 25th Street
Ogden, Utah 84401

*KLINE, LeROY N.
(Forester)
Oregon State Dept. of Forestry
P. O. Box 2289
Salem, Oregon 97310

KNOPF, JERRY A. E.
(Entomologist)
U. S. Forest Service
3320 Americana Terrace
Boise, Idaho 83706

KNOWLTON, DR. GEORGE F.
(Professor of Entomology)
Utah State University
Logan, Utah 84321

*KOERBER, T. W.
(Entomologist)
Pacific Southwest Forest and
Range Experiment Station
P. O. Box 245
Berkeley, California 94701

KOPLIN, JAMES R.
(Student)
Colorado State University
709 S. Washington
Fort Collins, Colorado 80521

LAMPI, ESLIE H.
(Forester)
National Park Service
1953 Kiva Road
Santa Fe, New Mexico 87501

*LANIER, GERRY
(Student)
Dept. of Entomology and
Parasitology
University of California
Berkeley, California 94704

LARA, ING. RAUL RODRIQUEZ
Seccion Entomologia
Instituto Nacional de
Investigacionea Forestales
Progresso No. 5
Coyaocan, D. F., Mexico

LARSEN, ALBERT T.
(Director)
Insect and Disease Control
State Dept. of Forestry
P. O. Box 2289
Salem, Oregon 97310

LAUCK, DR. DAVID R.
(Associate Professor)
Humboldt State College
Arcata, California 95521

*LAUTERBACH, PAUL G.
(Research Forester)
Weyerhaeuser Research Center
P. O. Box 420
Centralia, Washington 98531

*LEJEUNE, R. R.
(Regional Director)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

LEMBRIGHT, HAROLD W.
(Agriculturist)
Dow Chemical Co.
350 Sansome Street
San Francisco, California 94106

LISTER, KENDALL
U. S. Forest Service
Federal Office Building
324 - 25th Street
Ogden, Utah 84401

*LOWE, JAMES H. JR.
School of Forestry
University of Montana
Missoula, Montana 59801

LOWRY, DR. W. P.
Dept. of Statistics
School of Science
Oregon State University
Corvallis, Oregon 97331

LUCHT, DONALD
Federal Building
517 Gold Ave., S. W.
Albuquerque, New Mexico 87101

*LUCK, ROBERT F.
Dept. of Entomology and Parasitology
University of California
Berkeley, California 94704

LYON, DR. R. L.
(Entomologist)
Pacific Southwest Forest and Range Experiment Station
P. O. Box 245
Berkeley, California 94701

MAHONEY, JOHN
(Chief Forester)
National Park Service, R-4
180 New Montgomery Street
San Francisco, California 94105

MANIS, DR. H. C.
(Head)
Dept. of Entomology
University of Idaho
Moscow, Idaho 83843

MARSHALL, KNOX
Western Pine Association
1100 Tenth Avenue
Sacramento, California 95818

*MASON, RICHARD R.
Forest Science Laboratory
3200 Jefferson Way
Corvallis, Oregon 97331

MASSEY, DR. CALVIN L.
(Entomologist)
Rocky Mountain Forest and Range Experiment Station
P. O. Box 523
Albuquerque, New Mexico 87103

MATHERS, W. G.
(Administrative Officer)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

McCAMBRIDGE, W. F.
(Entomologist)
Rocky Mountain Forest and Range Experiment Station
Colorado State University
221 Forestry Building
Fort Collins, Colorado 80521

*McCOMB, DAVID
(Entomologist)
U. S. Forest Service
P. O. Box 3141
Portland, Oregon 97208

McGREGOR, M. D.
(Entomologist)
U. S. Forest Service
Forest Service Building
324 - 25th Street
Ogden, Utah 84401

McKINNON, F. S.
(Chief Forester)
B. C. Forest Service
Parliament Buildings
Victoria, B. C.

McKNIGHT, MELVIN E.
(Entomologist)
Rocky Mountain Forest and Range Experiment Station
Colorado State University
221 Forestry Building
Fort Collins, Colorado 80521

*McMULLEN, DR. L. H.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

*MESO, STANLEY W., JR.
(Forester)
U. S. Forest Service
Pacific Northwest Region
P. O. Box 3623
Portland, Oregon 97208

MITCHELL, DR. RUSSEL G.
(Entomologist)
Pacific Northwest Forest and
Range Experiment Station
P. O. Box 3141
Portland, Oregon 97208

MOGREN, DR. E. W.
(Associate Professor)
College of Forestry and
Range Management
Colorado State University
Fort Collins, Colorado 80521

*MOLNAR, ALEX C.
Department of Forestry
506 W. Burnside Road
Victoria, B.C.

MOORE, DR. A. D.
(Entomologist)
Pacific Southwest Forest and
Range Experiment Station
P. O. Box 245
Berkeley, California 94701

MORRIS, DR. O. N.
(Insect Pathologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

*NAGEL, DR. W. P.
(Associate Professor)
Dept. of Entomology
Oregon State University
Corvallis, Oregon 97331

NORIEGA, ING. HUMBERTO MORENO
Jefe del Dpto. de Sanidad
Forestal
Direccion de Proteccion
Forestal
Aquiles Serdan 28
Tercer Piso
Mexico 4, D. F.

*ORR, P. W.
(Entomologist)
U. S. Forest Service
P. O. Box 3623
Portland, Oregon 97208

*OTVAS, IMRE
(Student)
Dept. of Entomology and
Parasitology
University of California
Berkeley, California 94704

PEARSON, ERNEST
(Forester)
State Dept. of Forestry
P. O. Box 2289
Salem, Oregon 97310

PETTINGER, LEON F.
(Entomologist)
U. S. Forest Service
P. O. Box 3623
Portland, Oregon 97208

PIERCE, D. A.
(Entomologist)
U. S. Forest Service
Federal Building
517 Gold Avenue, S. W.
Albuquerque, New Mexico 87101

PIERCE, J. R.
(Entomologist)
U. S. Forest Service
630 Sansome Street
San Francisco, California 94111

PILLMORE, RICHARD E.
(Research Biologist)
Bureau of Sport Fisheries and Wildlife
Denver Federal Center, Bldg. 45
Denver, Colorado 80225

*PITMAN, GARY B.
(Entomologist)
Boyce Thompson Institute
P. O. Box 1119
Grass Valley, California 95945

*POWELL, JOHN M.
Canada Department of Forestry
102-11th Ave., E.
Calgary, Alberta

*REID, ROBERT WILLIAM
(Entomologist)
Department of Forestry
102 - 11th Avenue E.
Calgary, Alberta

*RICHMOND, H. A.
(Consulting Forest Entomologist)
Lofthouse Road
R. R. #2
Nanaimo, B. C.

RITCHER, DR. PAUL O.
(Head)
Dept. of Entomology
Oregon State University
Corvallis, Oregon 97331

*ROBINS, JACK
(Ranger Supervisor)
Dept. of Forestry
Forest Research Laboratory
102 - 11th Avenue E.
Calgary, Alberta

ROETTGERING, BRUCE
(Entomologist)
U. S. Forest Service
Box 1631
Juneau, Alaska 99801

ROSE, W. E.
(Entomologist)
Northern Forest Experiment Station
Box 740
Juneau, Alaska 99801

*ROSS, DR. D. A.
(Officer-in-Charge)
Forest Entomology Laboratory
Department of Forestry
Box 1030
Vernon, B. C.

RUBIO, SENOR FRANCISCO FERNANDEZ
Montrose Mexicana, S. A.
Ave. Madero No. 2-4, Piso
Postal 2124
Mexico 1, D. F.

*RUDINSKY, DR. JULIUS A.
(Professor)
Dept. of Entomology
Oregon State University
Corvallis, Oregon 97331

RYAN, DR. ROGER
(Entomologist)
Pacific Northwest Forest and Range Experiment Station
3200 Jefferson Way
Corvallis, Oregon 97331

*SAFRANYIK, LES
Department of Forestry
102 - 11th Avenue E.
Calgary, Alberta

SARTWELL, CHARLES, JR.
(Entomologist)
Pacific Northwest Forest and Range Experiment Station
P. O. Box 3141
Portland, Oregon 97208

*SCHAEFER, DR. C. H.
Shell Development Co.
P. O. Box 3011
Modesto, California 95353

*SCHENK, DR. JOHN A.
(Associate Professor)
University of Idaho
Moscow, Idaho 83843

*SCHMIDT, FRED H.
(Entomologist)
Pacific Northwest Forest and
Range Experiment Station
3200 Jefferson Way
Corvallis, Oregon 97331

*SCHMIEGE, DR. DONALD E.
(Entomologist) Visiting Professor
Northern Forest Experiment
Station
Box 740
Juneau, Alaska 99801

SCHMITZ, RICHARD F.
(Entomologist)
Intermountain Forest and
Range Experiment Station
Forest Service Building
Missoula, Montana 59801

SCHMUNK, OSCAR H.
(Assistant State Forester)
Colorado State Forest Service
Colorado State University
Fort Collins, Colorado 80521

SCOTT, DAVID O.
(Forester)
U. S. Forest Service
Federal Building
Missoula, Montana 59801

*SHEN, SAMUEL K.
Dept. of Entomology
Washington State University
Pullman, Washington 99163

*SHEPHERD, DR. ROY F.
(Entomologist)
Department of Forestry
Forest Research Laboratory
102 - 11th Avenue, East
Calgary, Alberta

*SILVER, DR. G. T.
Associate Regional Director
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

*SMITH, D. N.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

SMITH, ROBERT J.
(Forester)
National Park Service
P. O. Box 728
Santa Fe, New Mexico 87501

SMITH, DR. RICHARD H.
(Entomologist)
Pacific Southwest Forest and
Range Experiment Station
P. O. Box 245
Berkeley, California 94701

SPILSBURY, R. H.
(Forester-in-Charge)
Research Division
B. C. Forest Service
Victoria, B. C.

*STARK, DR. R. W.
(Associate Professor)
Dept. of Entomology and
Parasitology
University of California
Berkeley, California 94720

STELZER, MILTON J.
(Entomologist)
Rocky Mountain Forest and
Range Experiment Station
P. O. Box 523
Albuquerque, New Mexico 87103

*STEVENS, DR. ROBERT E.
(Chief)
Div. of Forest Insect Research
Pacific Southwest Forest and
Range Experiment Station
P. O. Box 245
Berkeley, California 94701

*STEVENSON, R. E.
(Entomologist)
Forest Research Laboratory
Department of Forestry
102 - 11th Avenue, East
Calgary, Alberta

STEWART, JAMES L.
U. S. Forest Service
Denver Federal Center
Denver, Colorado 80225

STRUBLE, G. R.
(Entomologist)
Pacific Southwest Forest and
Range Experiment Station
P. O. Box 245
Berkeley, California 94701

STURGEON, DR. E. E.
Division of Natural Resources
Humboldt State College
Arcata, California 95521

*TAYLOR, KARL B.
1706½ Opal St.
Pullman, Washington 99163

SWAIN, K. M.
(Entomologist)
c/o San Bernardino National For.
P. O. Box 112
San Bernardino, California 92401

TELFORD, DR. HORACE S.
(Chairman)
Dept. of Entomology
Washington State University
Pullman, Washington 99163

THATCHER, DR. T. O.
(Professor)
Dept. of Entomology
Colorado State University
Fort Collins, Colorado 80521

THOMAS, DR. G. P.
(Regional Director)
Forest Research Laboratory
Department of Forestry
102 - 11th Avenue, East
Calgary, Alberta

THOMPSON, DR. C. G.
(Entomologist)
Pacific Northwest Forest and
Range Experiment Station
3200 Jefferson Way
Corvallis, Oregon 97331

THOMPSON, HUGH E.
Dept. of Entomology
Kansas State University
Manhattan, Kansas 66502

*TRIPP, HOWARD A.
Canada Department of Forestry
102 - 11th Avenue, East
Calgary, Alberta

TROSTLE, GALEN C.
(Entomologist)
U. S. Forest Service
Federal Office Building
324 - 25th Street
Ogden, Utah 84401

TUNNOCK, SCOTT
(Entomologist)
U. S. Forest Service
Federal Building
Missoula, Montana 59801

*TURNER, J. A.
Canada Department of Forestry
506 W. Burnside Road
Victoria, B. C.

*WASHBURN, RICHARD I.
(Entomologist)
U. S. Forest Service
Forest Sciences Lab.
Box 469
Moscow, Idaho 83843

*WEAR, J. F.
(Research Forester)
Pacific Northwest Forest and Range Experiment Station
P. O. Box 3141
Portland, Oregon 97208

*WELLINGTON, DR. W. G.
(Entomologist)
Department of Forestry
Forest Research Laboratory
506 W. Burnside Road
Victoria, B. C.

WERNER, DR. F. C.
Dept. of Entomology
University of Arizona
Tucson, Arizona 85721

WERNER, DR. RICHARD A.
(Entomologist)
Forestry Science Laboratory
Southeastern Forest Experiment Station
P. O. Box 12254
Research Triangle Park, North Carolina 27709

*WICKMAN, BOYD E.
(Entomologist)
Pacific Southwest Forest and Range Experiment Station
P. O. Box 245
Berkeley, California 94701

*WILFORD, DR. B. H.
(Entomologist) (Retired)
Route 3, Box 524
Fort Collins, Colorado 80521

WILLIAMS, DR. CARROLL B., JR.
(Research Forester)
Pacific Southwest Forest and Range Experiment Station
P. O. Box 245
Berkeley, California 94701

WITTIG, DR. GERTRAUDE C.
(Microbiologist)
Pacific Northwest Forest and Range Experiment Station
3200 Jefferson Way
Corvallis, Oregon 97331

WOOD, DR. D. L.
(Entomologist)
Dept. of Entomology and Parasitology
University of California
Berkeley, California 94720

WRIGHT, KENNETH H.
(Entomologist)
Pacific Northwest Forest and Range Experiment Station
P. O. Box 3141
Portland, Oregon 97208

WYGANT, DR. NOEL D.
(Chief)
Div. of Forest Insect Research
Rocky Mountain Forest and Range Experiment Station
Colorado State University
221 Forestry Building
Fort Collins, Colorado 80521

YASINSKI, F. M.
(Entomologist)
U. S. Forest Service
Federal Building
517 Gold Avenue, S. W.
Albuquerque, New Mexico 87101

*ZINGY, JOHN G.
1332 Harrison Avenue
Centralia, Washington 98531

B. MEMBERS FROM OTHER REGIONS

ASHRAFF, M. A.
(Technical Supervisor)
Green Cross Products
110 Sutherland Avenue
Winnipeg, Manitoba

BAKER, W. L.
(Assistant Director)
Div. of Forest Insect Research
U. S. Forest Service
Washington, D. C. 20250

BARRAS, STANLEY J.
Research Entomologist
Southern Forest Experiment Station
2500 Shreveport Hwy.
Pineville, Louisiana 71360

BASKIN, DAVID A.
Velsicol Chemical Corp.
330 E. Grand Avenue
Chicago, Illinois 60611

BEAL, DR. J. A.
(Director)
Div. of Forest Insect Research
U. S. Forest Service
Washington, D. C. 20250

BEAN, JAMES L.
(Regional Entomologist)
U. S. Forest Service
6816 Market St.
Upper Darby, Pennsylvania 19082

BONGBERG, J. W.
(Director)
Div. of Forest Pest Control
U. S. Forest Service
Washington, D. C. 20250

BUSHLAND, RAYMOND C.
(Lab. Director)
U. S. D. A., A. R. S.
Entomology Research Division
Metabolism and Radiation Laboratory
Fargo, N. D. 58102

BUTCHER, JAMES W.
(Professor)
Michigan State University
East Lansing, Michigan 48823

CAMPBELL, IAN M.
Iowa State University
2711 Northwood
Ames, Iowa 50010

CARLSON, S. T.
(Chief)
Br. of Park Forest and Wildlife Protection
National Park Service
Room 244, Interior Building
Washington, D. C. 20240

COSTER, JACK E.
(Forester)
U. S. Bureau of Land Management
249 No. Wolcott
Casper, Wyoming 82601

COTTRELL, HERBERT, C.
(Assistant State Forester)
Wyoming Forestry Division 113
Capitol Building
Cheyenne, Wyoming 82001

DICKISON, FRED F.
(Forester)
U. S. D. A.
National Park Service
Midwest Region
1709 Jackson Street
Omaha, Nebraska 68102

DONLEY, DAVID E.
(Project Leader)
Forest Insect Laboratory
287 W. Hoffner Street
Delaware, Ohio 43015

FETTES, DR. J. J.
(Director)
Chemical Control Research Institute
Department of Forestry
Central Experimental Farm
K. W. Neatby Building
Ottawa, Ontario

FLINCK, PAUL R.
(Entomologist)
Forestry Section
Conservation Department
1110 Morris Avenue
Lansing, Michigan 48917

GARA, ROBERT I.
(Entomologist)
Boyce Thompson Institute
P. O. Box 2489
Beaumont, Texas 77704

GRAY, DAVID E.
Canada Department of Forestry
Motor Building
238 Sparks Street
Ottawa, Ontario

GREEN, DR. GEORGE W.
(Entomologist)
Canada Dept. of Forestry
Forest Insect Laboratory
P. O. Box 490
Sault Ste. Marie, Ontario

HARRISON, ROBERT P.
(Entomologist)
Dow Chemical Co.
Box 512
Midland, Michigan 48640

HOFFMAN, DR. CLARENCE H.
(Associate Director)
U. S. Department of Agriculture
Entomology Research Division
Plant Industry Station
Beltsville, Md. 20705

JOHNSON, CARL E.
(State Forester)
State of Wyoming
Capitol Building
Cheyenne, Wyoming 82001

KIRBY, CALVIN S.
(Entomologist)
Canada Department of Forestry
114 Ruggles Avenue
Richmond Hill, Ontario

KNIGHT, DR. FRED B.
(Associate Professor)
School of Natural Resources
Department of Forestry
University of Michigan
Ann Arbor, Michigan 48104

LANDGRAF, AMEL E., JR.
(Forester)
U. S. Forest Service
50 Seventh St., N.E.
Atlanta, Georgia 30323

LEWIS, FRANKLIN B.
(Insect Pathologist)
U. S. Forest Service
Northeastern Forest Experimental Station
135 Wood Street
West Haven, Conn. 06516

McCLANAHAN, W. DEAN
(Forester)
Br. of Park Forest and Wildlife Protection
National Park Service
Washington, D. C. 20240

McGUGAN, DR. B. M.
(Director of Program Coordination)
Department of Forestry
Room 226, Motor Building
238 Sparks Street
Ottawa, Ontario

MERKEL, E. P.
(Entomologist)
Southern Forest Experiment Station
P. O. Box 3
Olustee, Florida 32072

MILLER, WILLIAM E.
(Insect Ecologist)
Lake States Forest Exp. Station
University of Minnesota
St. Paul, Minnesota 55102

PARKER, LANSING A.
(Associate Director)
Bureau of Sport Fisheries & Wildlife
4819 N. 24th Road
Arlington, Virginia 22207

PARR, DR. THAD
(Research Supervisor)
Chemagro Corporation
Box 4913
Hawthorne Rd.
Kansas City, Missouri 64120

PREBBLE, DR. M. L.
(Assistant Deputy Minister Forestry)
Department of Forestry
Victoria Building
140 Wellington St.
Ottawa, Ontario

REEKS, WILFRID A.
(Program Coordinator - Entomology)
Canada Dept. of Forestry
Motor Building
238 Sparks Street
Ottawa, Ontario

RENLUND, DONALD W.
(Supervisor Forest Pest Survival and Control)
Wisconsin Conservation Dept. Forest Entomology
Route 2
Nevin Hatchery
Madison, Wisconsin 53713

ROSE, ARTHUR H.
(Entomologist)
Forest Insect Laboratory
P. O. Box 490
Sault Ste. Marie, Ontario

SCHUDER, DONALD L.
Purdue University
2319 Sycamore Lane
W. Lafayette, Indiana 47906

*SIMEONE, DR. JOHN B.
(Chairman)
Dept. of Forest Entomology
New York State College of Forestry
Syracuse, New York 13210

STEHR, DR. G. W. K.
(Entomologist)
Forest Insect Laboratory
Dept. of Forestry
Box 490
Sault Ste. Marie, Ontario

*SULLIVAN, C. R.
(Entomologist)
Forest Insect Laboratory
Dept. of Forestry
Box 490
Sault Ste. Marie, Ontario

THATCHER, ROBERT C.
(Entomologist)
Southern Forest Experiment Stn.
c/o Stephen F. Austin College
P. O. Box 345
Nacogdoches, Texas 75962

*THOMAS, BOYD
(Entomologist)
Canada Dept. of Forestry
P. O. Box 490
Sault Ste. Marie, Ontario

TURNOCK, DR. WILLIAM J.
(Entomologist)
Canada Dept. of Forestry
Forest Research Laboratory
Box 6300
Winnipeg 1, Man.

WALLNER, WILLIAM E.
(Asst. Professor)
Michigan State University
5004 Park Lake Road
East Lansing, Michigan 48823

WEBB, DR. FRANK E.
Associate Regional Director
Canada Dept. of Forestry
Forest Research Laboratory
College Hill
Fredericton, New Brunswick

WRICH, M. J.
(Entomologist)
Chemagro Corporation
722 W. 6th Street
Sioux Falls, South Dakota 57104